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An Atlas of ECMWF Analyses (1980-87)

Part I - First Moment Quantities

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I. INTRODUCTION

The Goddard Laboratory for Atmospheres (GLA) has over the past few years acquired a large data base of 00Z and 12Z initialized analyses (1980-87) from the European Center for Medium Range Weather Forecasts (ECMWF). In support of our ongoing research activities we have found it convenient to compile these analyses in the form of an atlas.

The original ECMWF/WMO data was obtained on a 2.5° latitude by 2.5° longitude grid in a packed format. This data was unpacked and interpolated to a 4° latitude by 5° longitude grid for the purpose of computing various statistics and plotting. Appendix A describes further details of the data and data processing. In part I of this atlas we present various first moment quantities for monthly, seasonal and annual averages on a global cylindrical projection as well as cross section maps of zonal averages. We also present the average seasonal cycle and anomalies during the 8 year period for selected quantities. Part II presents various second moment quantities including both transient and standing eddy components. This includes some time filtered quantities which separate the contributions of the band pass (2.5 - 6 days) and low pass (> 10 days) regions of the spectrum.

The ECMWF analysis system has undergone a number of changes during the period 1980-87. Trenberth and Olson (1988) have done an extensive study of the ECMWF analyses for 1979-86 and examined the impact of analysis system changes on data quality. (see their Table I and discussion). The change to diabatic nonlinear normal mode initialization in September of 1982 dramatically increased the strength of the tropical divergence. For quantities sensitive to the divergence we have limited the time averages to 1984-87. For these fields the shorter time-averaging period is clearly indicated. Otherwise the averages include all 8 years. It must be emphasized that many other changes occurred to the analysis system during this time period leading to inhomogeneities in the data. This is particularly true for the moisture fields (see eg. Trenberth and Olson, 1988). No attempt has been made to take this into account when performing the time averages.

We note that other recent compilations of assimilated data that may be useful for comparisons are those of Trenberth and Olson (1988) based on essentially the same data (1979-86) and Lau (1984) which examines the FGGE year based on analyses produced at GFDL.

In accordance with ECMWF conditions any publications making use of the figures and/or data in this atlas must acknowledge ECMWF as the data source.

II. LIST OF QUANTITIES

The following lists the quantities and units used for plotting. The contour intervals are easily seen from the plots themselves. The global maps consist primarily of the 850 and 200 mb fields. Exceptions to this are the height field which is presented at 300 mb, the vertical velocity which is presented at 500 mb and the moisture field which is shown only at 850 mb. The cross sections are based on all the levels obtained from ECMWF which are 1000, 850, 700, 500, 300, 200, and 100 mb. Plots are shown for monthly, seasonal and annual averages. Our organization of the fields follows essentially that of Lau (1984)

The basic quantities and units (for the plots) are

1) U	east/west component of wind	m/s
2) V	north/south component of wind	m/s
3) T	temperature	°K
4) Z	geopotential height	m
5) Z_e	eddy geopotential height (zonal mean removed)	m
6) Q	specific humidity ¹	g/kg
7) ω	vertical velocity	nanobars/s
8) ψ	stream function	$m^2/s \times 10^6$
9) χ	velocity potential	$m^2/s \times 10^6$
10) p_s	sea level pressure ²	mb

The fields are grouped according to whether they are monthly, seasonal or annual averages. Within each group the global maps are presented first followed by the zonal averages denoted by brackets ([...]). The final maps present the seasonal cycle and anomalies (monthly deviations from the seasonal cycle) of selected zonal averaged fields. We indicate below the quantities and (for convenience) the relative positions of the plots in the atlas for each data group.

¹The original field was relative humidity. See Appendix A for the conversion to specific humidity.

²See Appendix A for the sea level pressure calculation from the height and temperature field.

<u>Quantity</u>		<u>Relative Position</u>
U	850 mb	1
U	200 mb	1
V	850 mb	2
V	200 mb	2
T	850 mb	3
T	200 mb	3
Z	300 mb	4
Z _e	300 mb	4
Q	850 mb	5
ω	500 mb	5
ψ	850 mb	6
ψ	200 mb	6
χ	850 mb	7
χ	200 mb	7
p _s	sea level	8
[U]		9
[V]		9
[ω]	(1980-83)	10
[ω]	(1984-87)	10
[Q]		11
[T]		11

The following quantities describe the seasonal cycle which is the average over all years (1980-87). We also show the difference between the first and last 4 years (1984/87-1980/83). These quantities appear after the annual averages.

<u>Quantity</u>		<u>Relative Position</u>
[U]	200 mb seasonal cycle	1
[U]	200 mb seasonal cycle (1984/87-1980/83)	1
[U]	850 mb seasonal cycle	2
[U]	850 mb seasonal cycle (1984/87-1980/83)	2
[V]	200 mb seasonal cycle	3
[V]	200 mb seasonal cycle (1984/87-1980/83)	3
[V]	850 mb seasonal cycle	4
[V]	850 mb seasonal cycle (1984/87-1980/83)	4
[T]	200 mb seasonal cycle	5
[T]	200 mb seasonal cycle (1984/87-1980/83)	5
[T]	850 mb seasonal cycle	6
[T]	850 mb seasonal cycle (1984/87-1980/83)	6
[Q]	850 mb seasonal cycle	7
[Q]	850 mb seasonal cycle (1984/87-1980/83)	7
[ω]	500 mb seasonal cycle	8
[ω]	500 mb seasonal cycle (1984/87-1980/83)	8

The anomalies are the monthly averaged deviations from the seasonal cycle. For [V], [ω], and [Q] we remove separately the seasonal cycle for 1980-83 and 1984-87.

<u>Quantity</u>		<u>Relative Position</u>
[U]*	200 mb anomalies	1
[U]*	850 mb anomalies	2
[V]*	200 mb anomalies	3
[V]*	850 mb anomalies	4
[ω]*	500 mb anomalies	5
[T]*	200 mb anomalies	6
[T]*	850 mb anomalies	7
[Q]*	850 mb anomalies	8

Appendix B describes how to access these data sets on the Amdahl V7 and V6.

III. REFERENCES

Lau, N-C., 1984: Circulation statistics based on FGGE level III-B analyses produced at GFDL. **NOAA Data Report ERL GFDL-5.**

Trennberth, K.E., 1981: Seasonal variations in global sea level pressure and the total mass of the atmosphere. **J. Geophys. Rev.**, **86**, 5238-5246

Trennberth, K. E. and J. G. Olson, 1988: ECMWF Global Analyses 1979-1980 : Circulation Statistics and Data Evaluation. **NCAR/TN-300+STR**, NCAR Technical Note, February, 1988, National Center for Atmospheric Research, Boulder, Colorado.

IV. APPENDIX A- THE DATA PROCESSING

The ECMWF analyses are the initialized fields provided to GLA (code 611) in an internal bit format. The data processing involves several steps including unpacking and converting to a 2 X 2.5 degree grid. During this step the relative humidity is converted to specific humidity and the sea level pressure is computed. Then an interpolation is made to a 4 X 5 degree grid. The stream function and velocity potential are computed from the lower resolution monthly-averaged fields. Both resolutions of the basic parameters are available on tape but all plotting is done from the lower resolution fields. Further details of the data are provided below.

ORIGINAL PACKED DATA AS RECEIVED FROM ECMWF:

2.5° latitude by 2.5° longitude in internal bit format
1000, 850, 700, 500, 300, 200, 100 hPa
separate 00Z and 12Z tapes

DATA (IM,JNP)

IM= 1, .. , 144 starting at 177.5 W and going east to 180 E
JNP = 1, .. , 73 starting at North Pole

- (1) geopotential height (m)
- (2) temperature (°K)
- (3) u (m/s)
- (4) v (m/s)
- (5) relative humidity (%)
- (6) vertical velocity (Pa/s)

UNPACKED ECMWF DATA (Version 8 format)

2° latitude by 2.5° longitude or 4° latitude by 5° longitude
In version 8 format (see documentation- VERSION 8 I/O utilities)
1000, 850, 700, 500, 300, 200, 100 hPa
00Z and 12Z combined for each tape

DATA(IM,JNP)

IM=1, .. , 144 (72) starting at 180° W and going east to 177.5° E (175° E)
JNP= 1, .. , 91 (46) starting at South Pole

Quantity

- (1) sea level pressure (hPa)
- (2) geopotential height (m)
- (3) temperature (°K)
- (4) u (m/s)
- (5) v (m/s)
- (6) specific humidity (g/g)
- (7) vertical velocity (Pa/s)
- (8) divergence

The specific humidity (q) is computed from the relative humidity

$$q = q_s * RH * 0.01$$

where

$$q_s = 0.622 * e_s / (p - .378 e_s)$$

and e_s is the saturation vapor pressure determined from the empirical formulae

$$\begin{array}{ll} 6.1078 * \text{EXP} \{ 21.8747 * (T - 273.16) / (T - 7.66) \} & \text{for } T \leq 273.16 \\ 6.1078 * \text{EXP} \{ 17.269 * (T - 273.16) / (T - 35.86) \} & \text{for } T > 273.16 \end{array}$$

The computation of sea level pressure (p_{sl}) is based on the hypsometric equation and an assumed lapse rate (see eg. Trenberth, JGR, 86, C6) so that

$$p_{sl} = 1000 * \text{EXP} (9.81 * Z / R T_v)$$

where Z is the height of the 1000 hPa surface and the mean virtual temperature (T_v) is given by

$$T_v = T * (1 + 0.61 * q) + 0.5 * (0.0065 * Z)$$

V. APPENDIX B- SOURCES OF DIGITIZED DATA

The data fields (for Part I of this Atlas) are currently stored in the MVS partitioned data set (PDS), W3CKP ECMWF ATLAS and are meant for use by NASA scientists with access to the Amdahl mainframe. This file will also be made available on the IBM 3081. We also anticipate that these fields will be made available on floppy disks for both IBM compatible and Macintosh personal computers in the near future. For further information concerning the use of this data contact

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(301) 286-3441

1. MVS JCL and CMS EXEC

- a) //FT11F001 DD DSN=W3CKP.ECMWF.ATLAS(xxxxxx),DISP=SHR
- b) FI 11 * DSN W3CKP ECMWF ATLAS (MEMBER xxxxxx

Here, xxxxx is the PDS member name.

2. Read format and PDS member names

Longitude/Latitude Fields

MEMBERS:

SLP	sea level pressure (mb)	
U200	u-wind at 200 mb (m/s)	
U850	u-wind at 850 mb (m/s)	
V200	v-wind at 200 mb (m/s)	
V850	v-wind at 850 mb (m/s)	
Z300	geopotential height at 300 mb (m)	
T200	temperature at 200 mb (°K)	
T850	temperature at 850 mb (°K)	
Q850	specific humidity at 850 mb (g/g)	
W500	omega at 500 mb (Pa/s)	(1984-87 average)
VEL200	velocity potential at 200 mb (m ² /s)	(1984-87 average)
VEL850	velocity potential at 200 mb (m ² /s)	(1984-87 average)
STF850	stream function at 850 mb (m ² /s)	
STF200	stream function at 200 mb (m ² /s)	

	REAL FLD(72,46)	
	DO 100 IMON = 1, 12	
100	READ(n) I, FLD	: MONTHLY MEAN (JAN-DEC)
	DO 200 ISN = 1, 4	
200	READ(n) INDEX, FLD	: SEASONAL MEAN (DJF-SON)
	READ(n) INDEX, FLD	: ANNUAL MEAN

FLD(I,J) J= 1 is at the South Pole and I=1 is at 180° W (increasing eastward to 175 E)

Latitude/Pressure Sections

MEMBERS:

LTPQ	zonally-averaged specific humidity (g/g) (1980-87)
LTPT	zonally-averaged temperature (°K) (1980-87)
LTPU	zonally-averaged u-wind (m/s) (1980-87)
LTPV	zonally-averaged v-wind (m/s) (1984-87)
LTPW1	zonally-averaged vertical velocity (Pa/s) (1980-83)
LTPW2	zonally-averaged vertical velocity (Pa/s) (1984-87)

DIMENSION LTP(46,7)

DO 100 IMON = 1, 12

100 READ(n) INDEX, LTP : MONTHLY MEAN (JAN-DEC)

DO 200 ISN = 1, 4

200 READ(n) INDEX, LTP : SEASONAL MEAN (DJF-SON)

READ(n) INDEX, LTP : ANNUAL MEAN

LTP(J,L) J= 1 is at the South Pole and L=1 is at 1000 mb. The other pressure levels are 850mb, 700mb, 500mb, 300mb, 200mb, 100mb.

Seasonal cycle climatology

MEMBERS : CLI8087, CLI8083, CLI8487

DIMENSION CLI(12,46)

DO 100 IV = 1, 8

READ(n) INDEX, CLI

100 CONTINUE

CLI(K,J) J= 1 is at the South Pole and K=1 is January.

IV

Quantity

1	zonally-averaged u-wind at 200 mb (m/s)
2	zonally-averaged u-wind at 850 mb (m/s)
3	zonally-averaged v-wind at 200 mb (m/s)
4	zonally-averaged v-wind at 850 mb (m/s)
5	zonally-averaged temperature at 200 mb (°K)
6	zonally-averaged temperature at 850 mb (°K)
7	zonally-averaged specific humidity (g/g)
8	zonally-averaged vertical velocity (Pa/s)

Departure from seasonal cycle

MEMBER : DEP8087

DIMENSION DEP(96,46)

DO 100 IV = 1, 8

READ(n) INDEX, DEP

100 CONTINUE

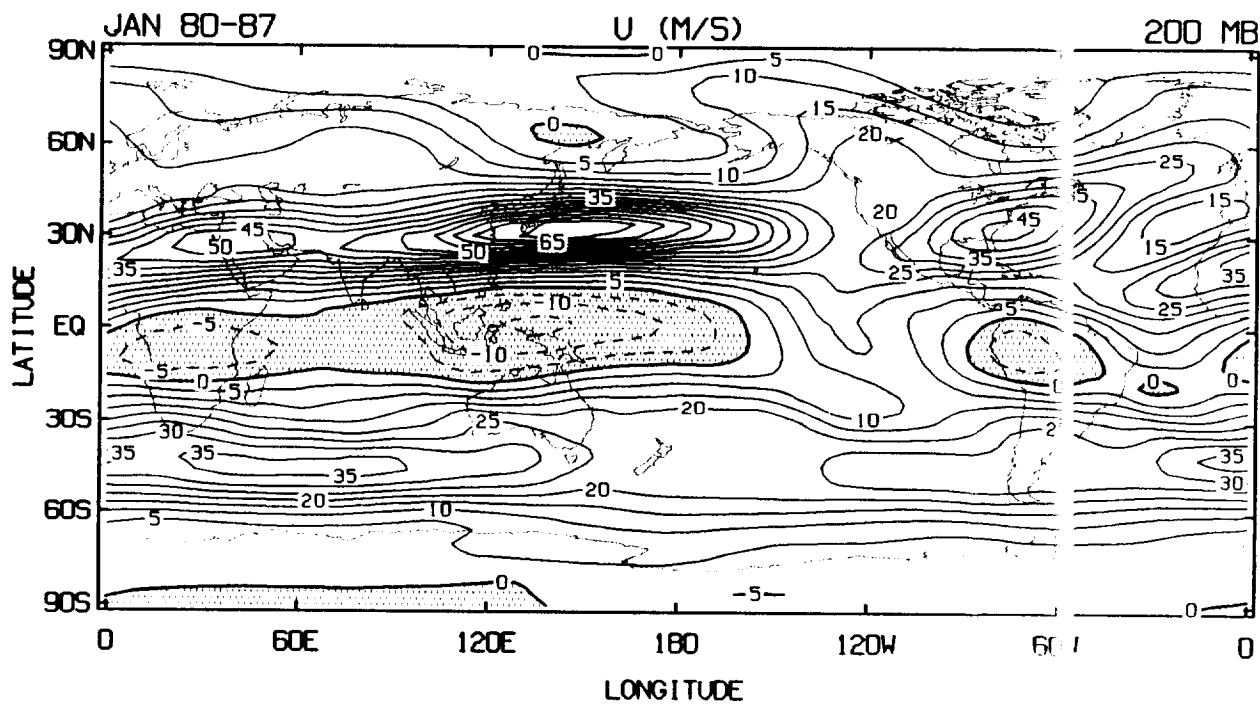
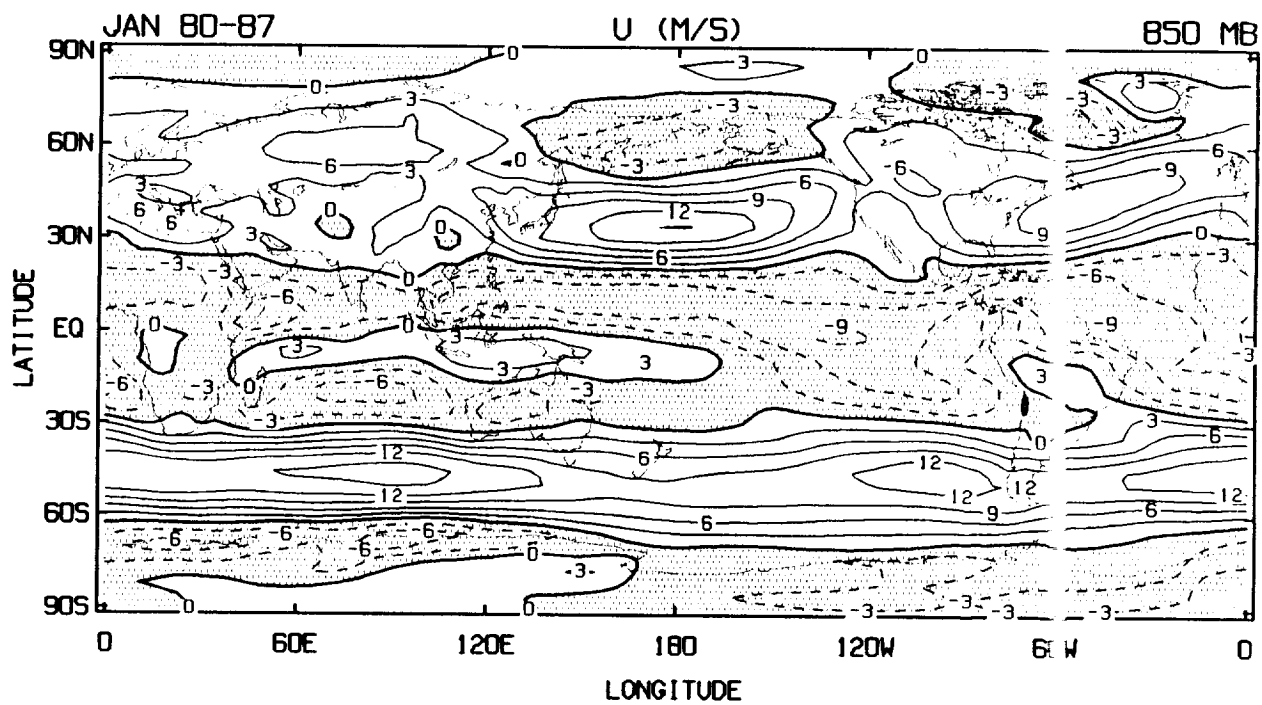
DEP(K,J) J= 1 is at the South Pole and K=1 is January, 1980.

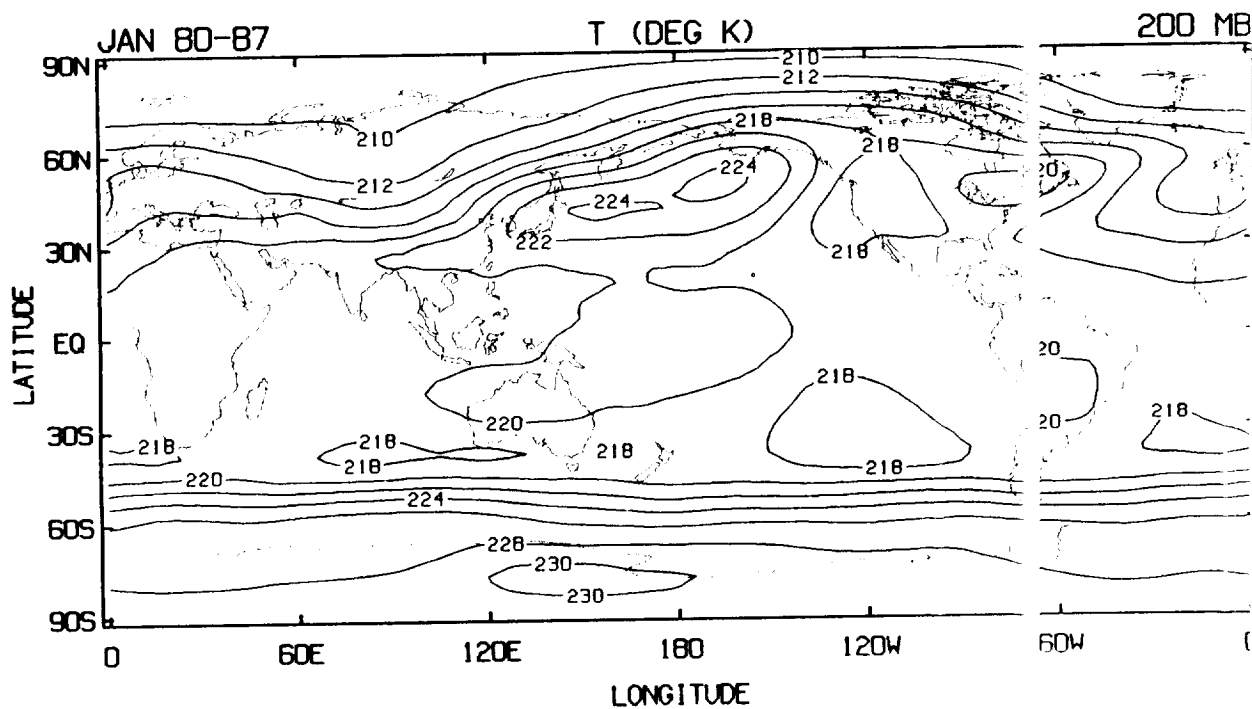
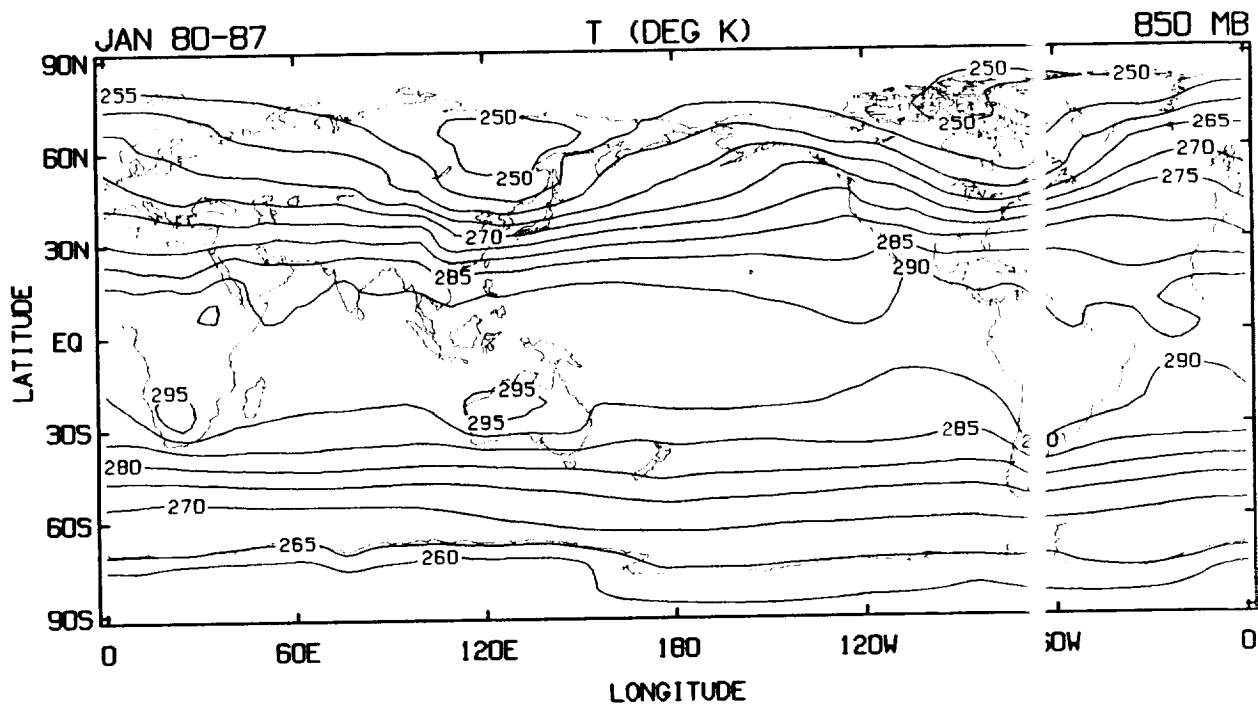
<u>IV</u>	<u>Quantity</u>
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2	zonally-averaged u-wind at 850 mb (m/s)
3	zonally-averaged v-wind* at 200 mb (m/s)
4	zonally-averaged v-wind* at 850 mb (m/s)
5	zonally-averaged temperature at 200 mb (°K)
6	zonally-averaged temperature at 850 mb (°K)
7	zonally-averaged specific humidity* (g/g)
8	zonally-averaged vertical velocity* (Pa/s)

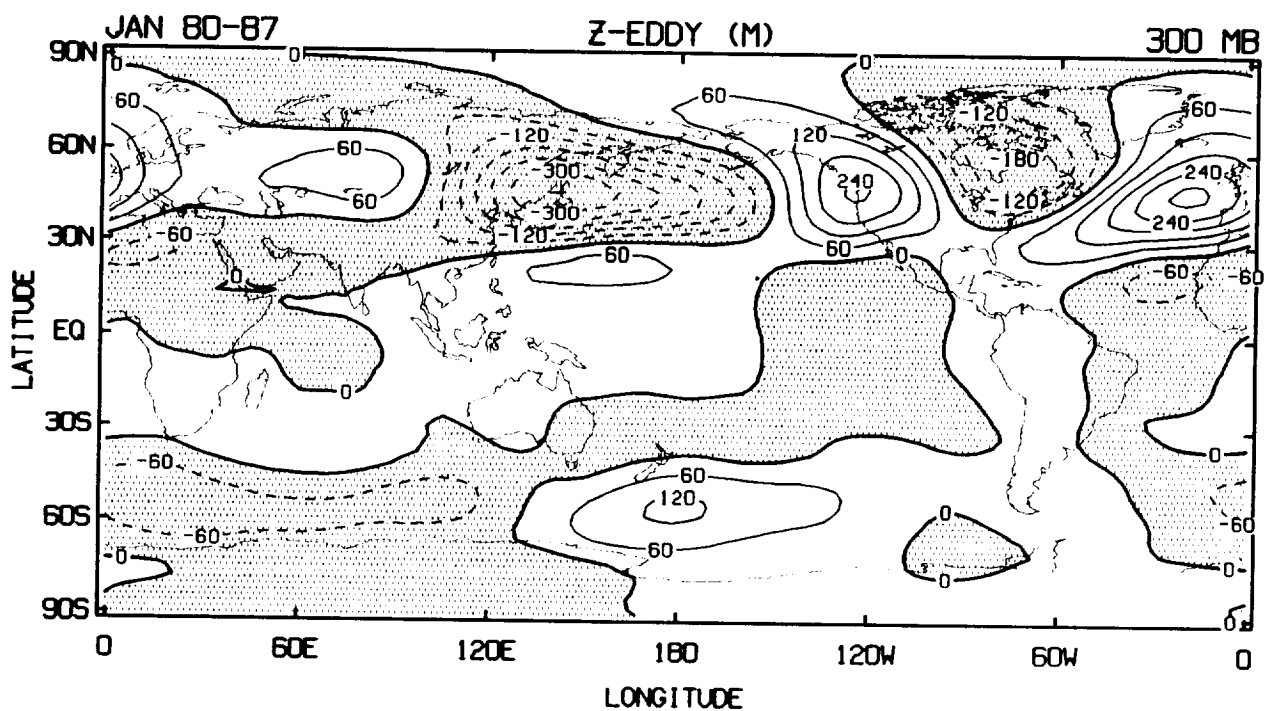
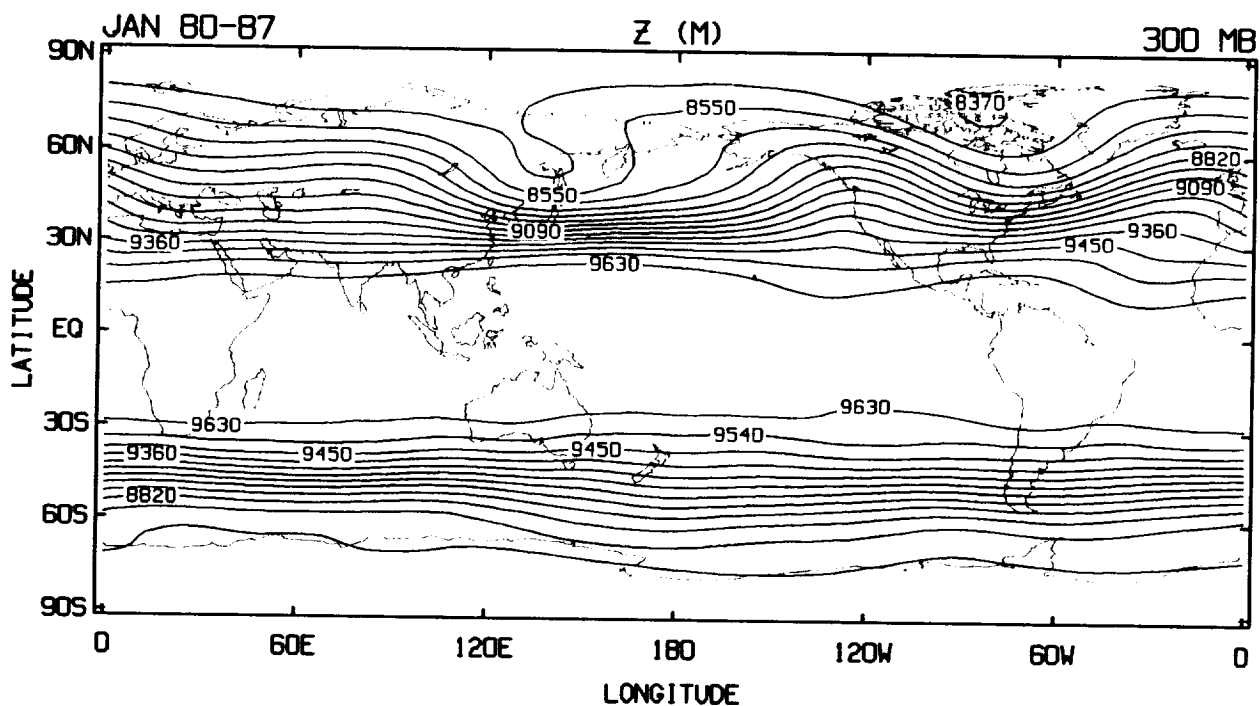
* These anomaly fields are based on separate climatologies for 1980-83 and 1984-87.

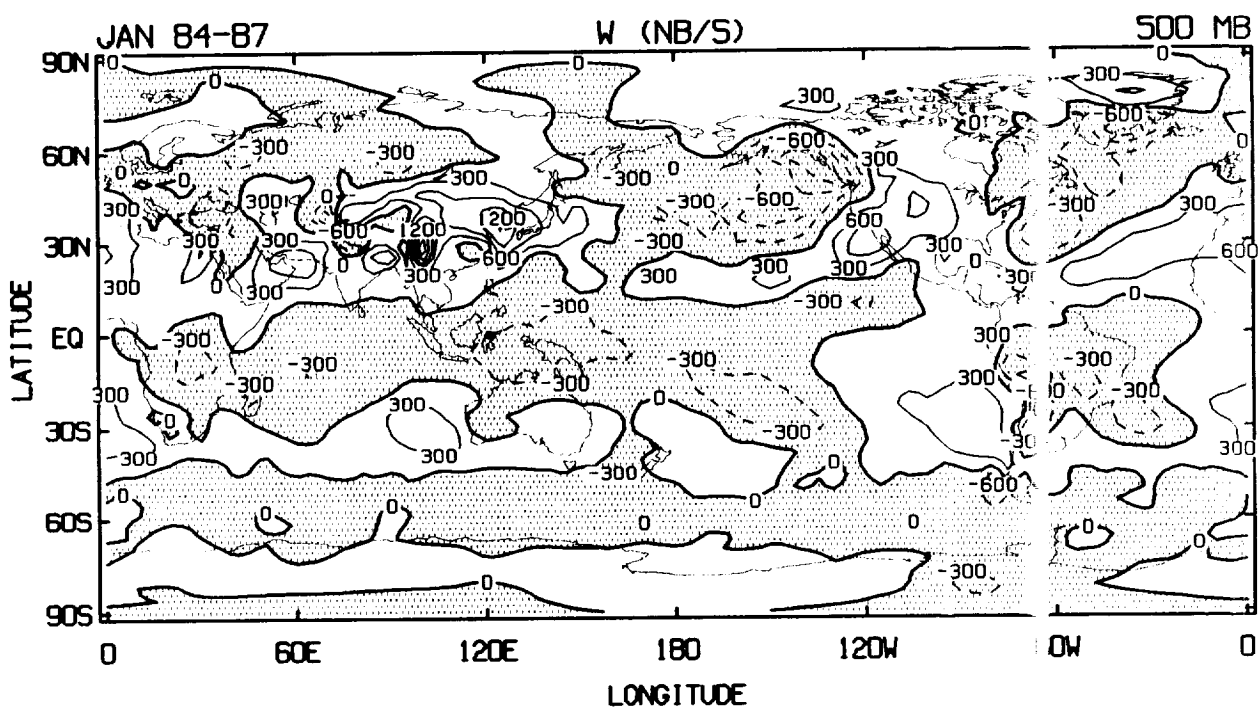
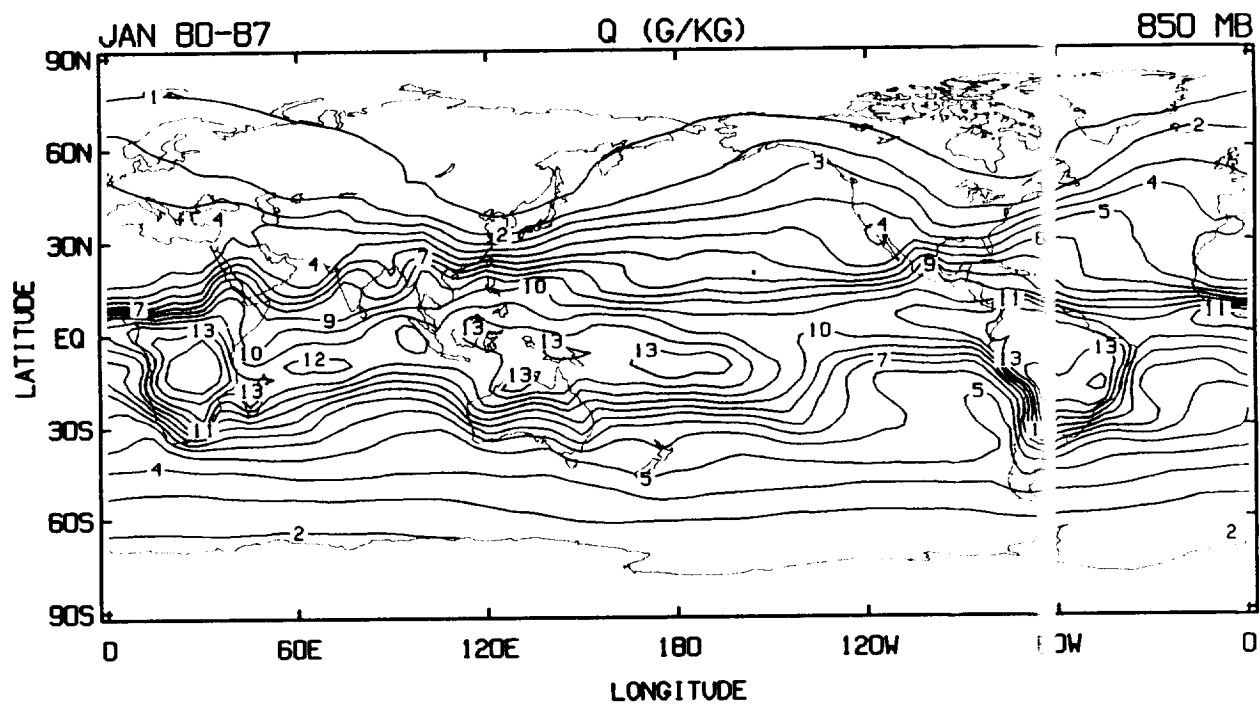
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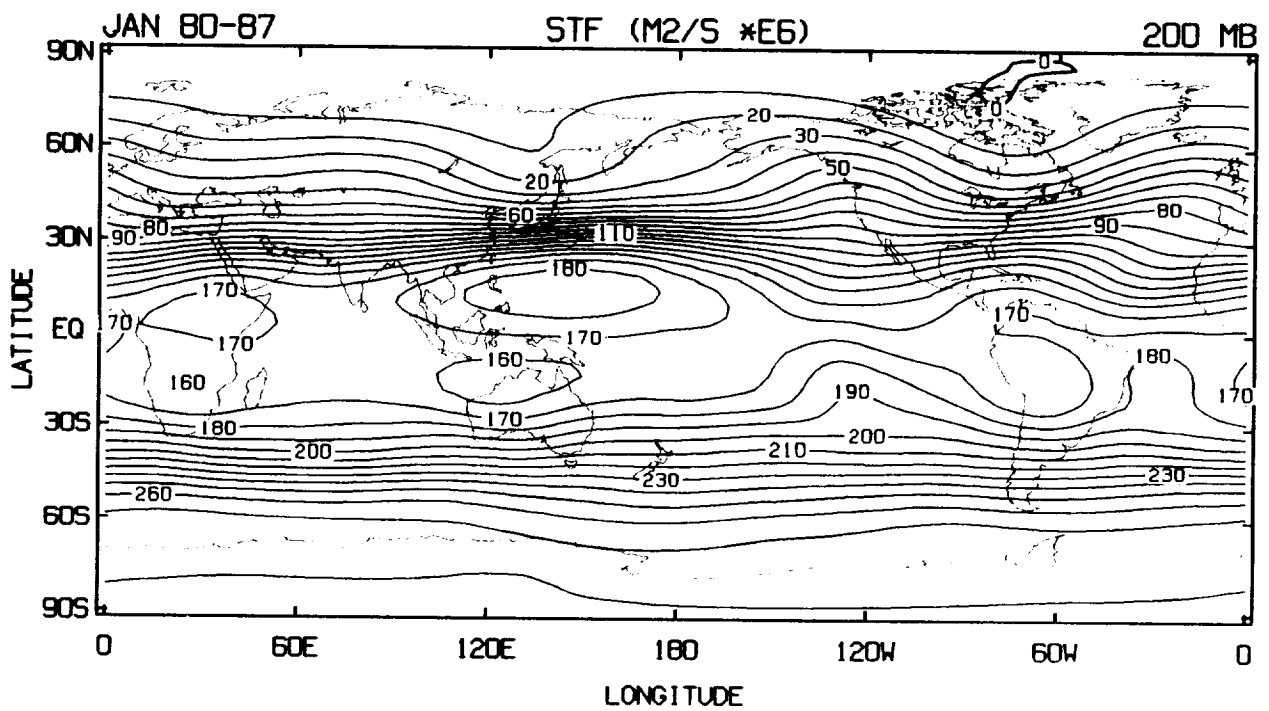
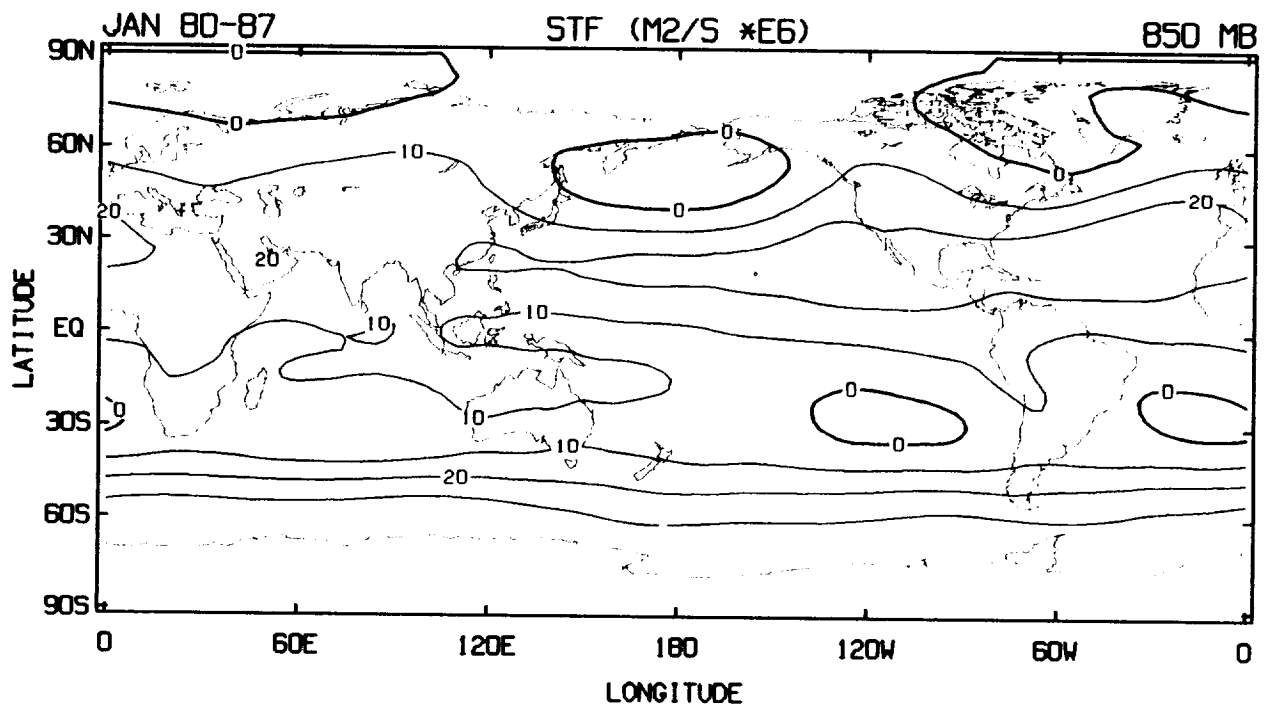
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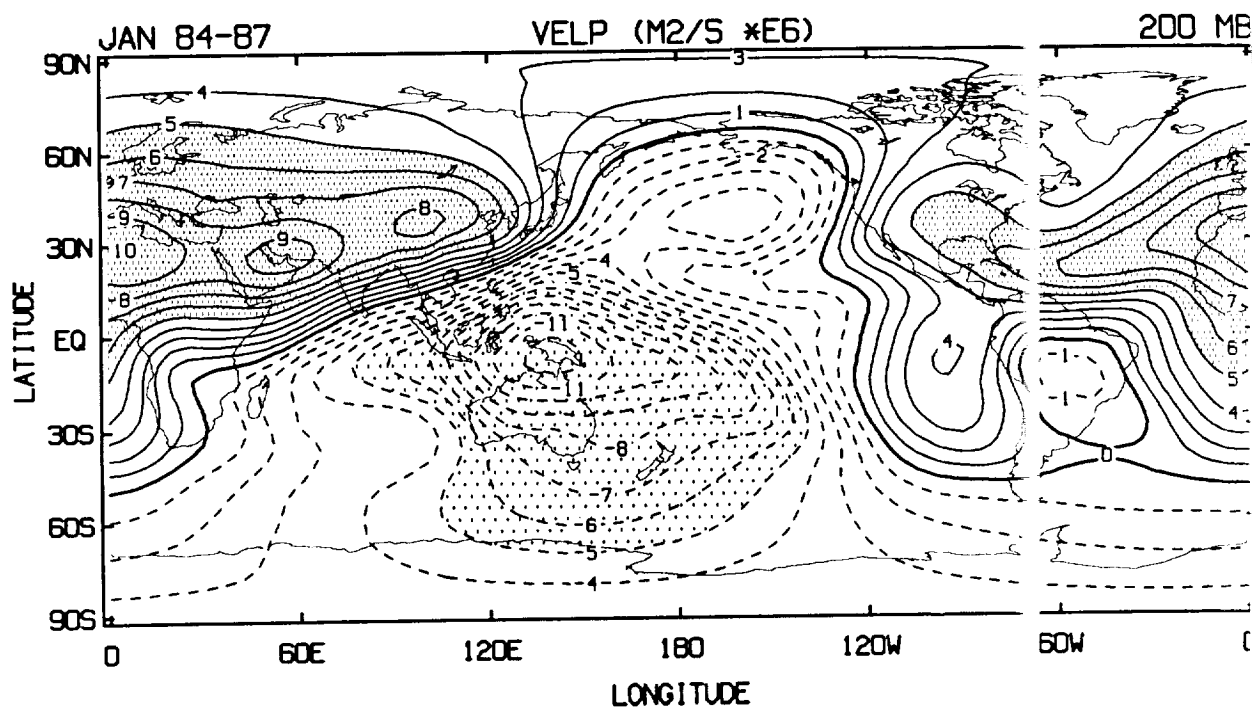
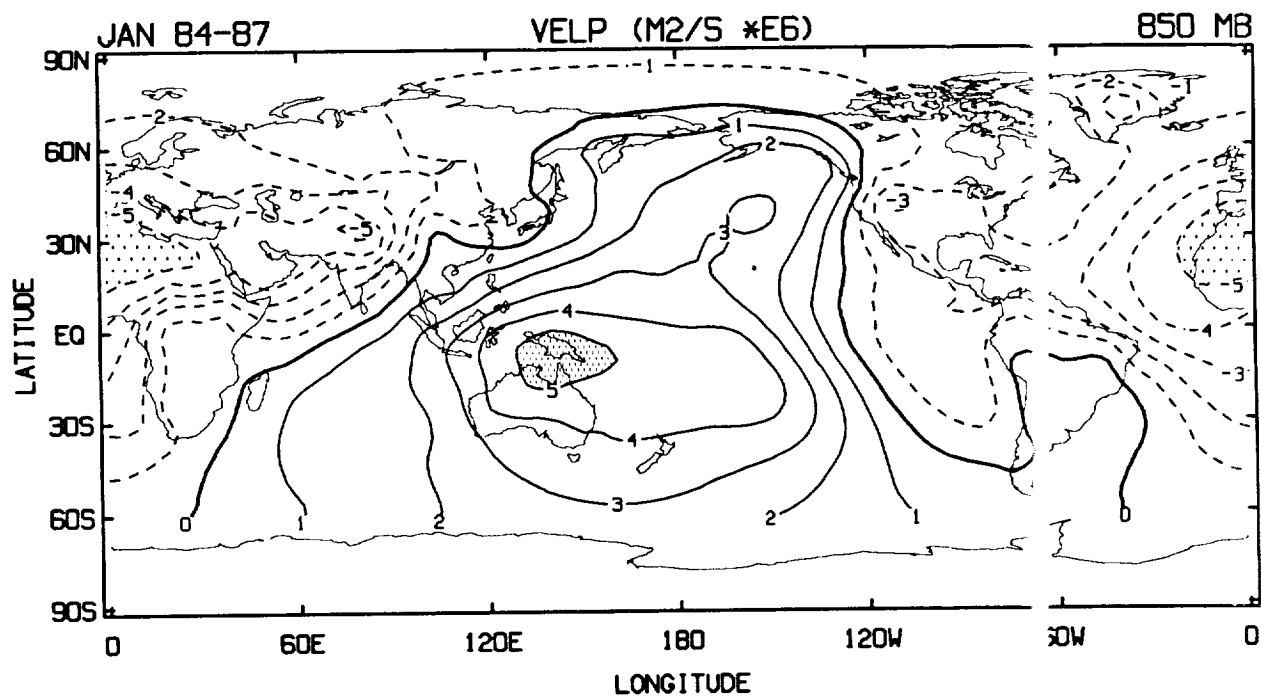


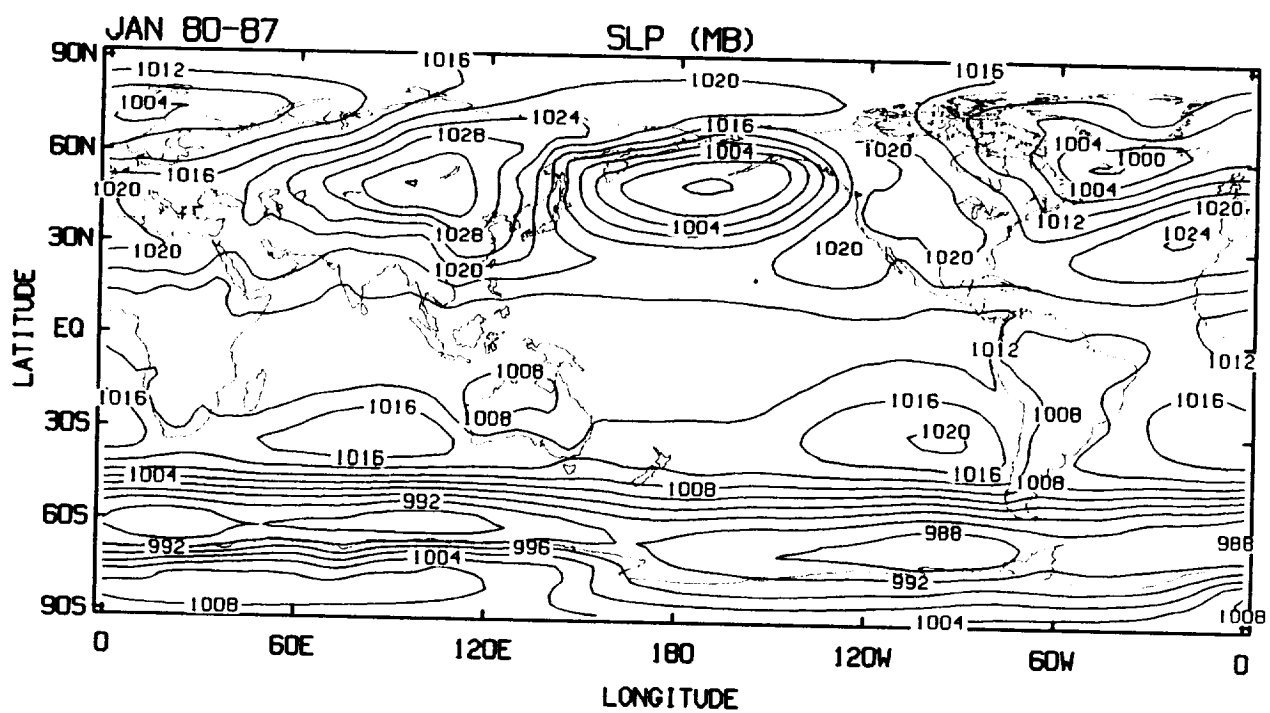


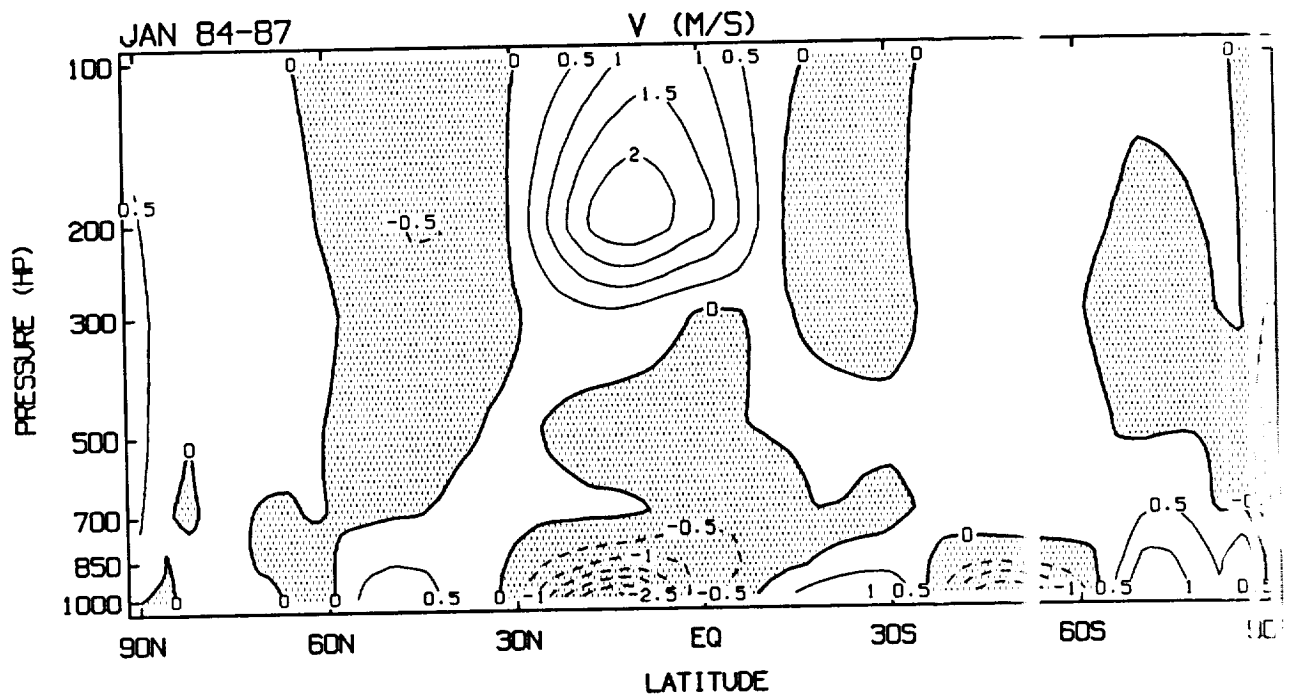
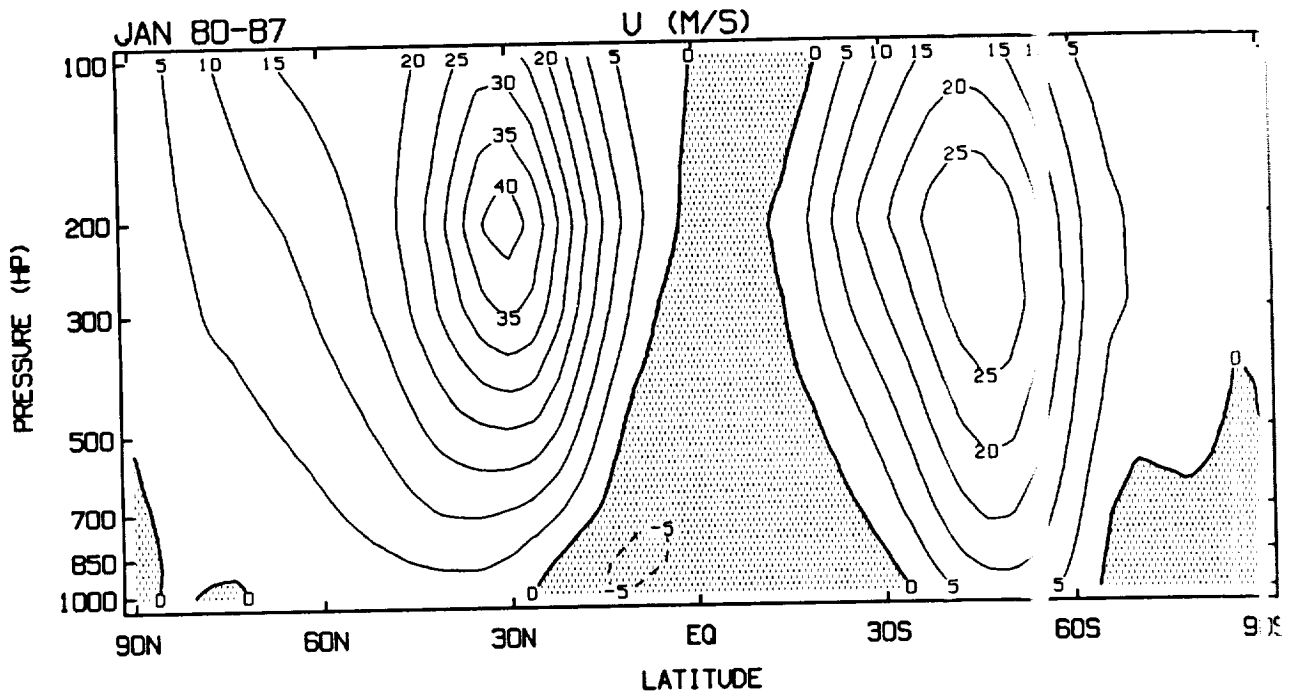


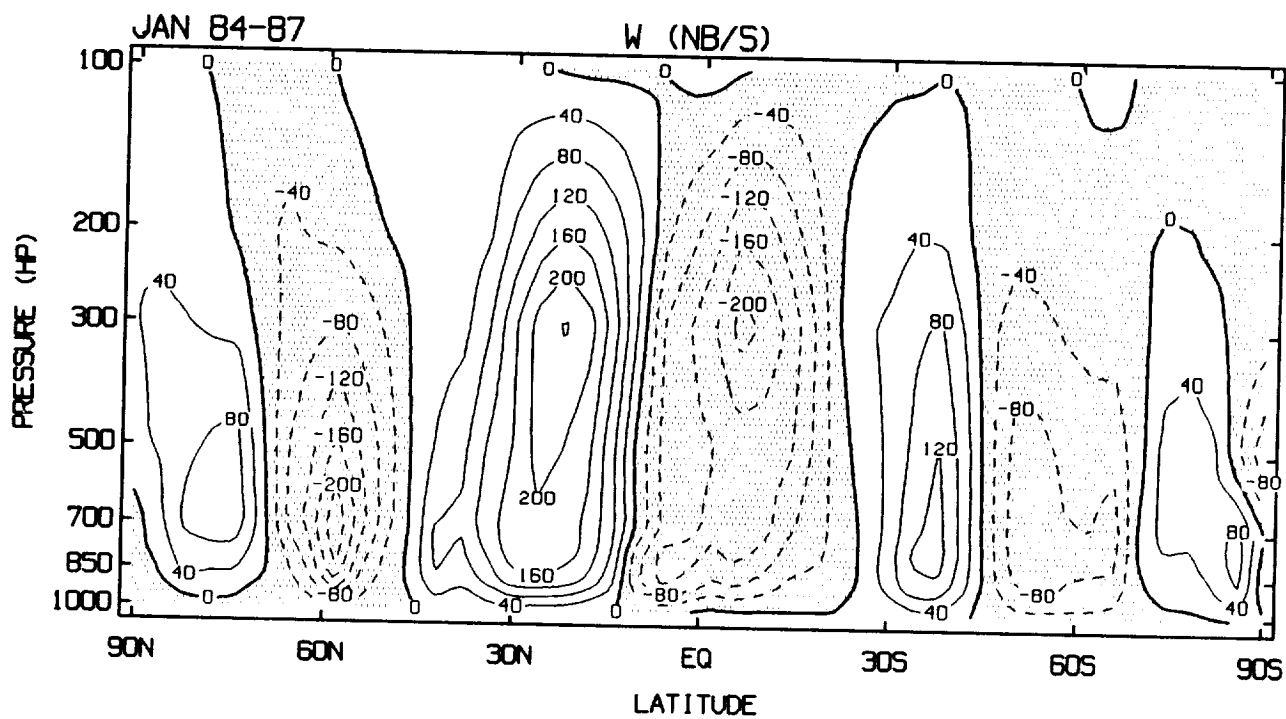
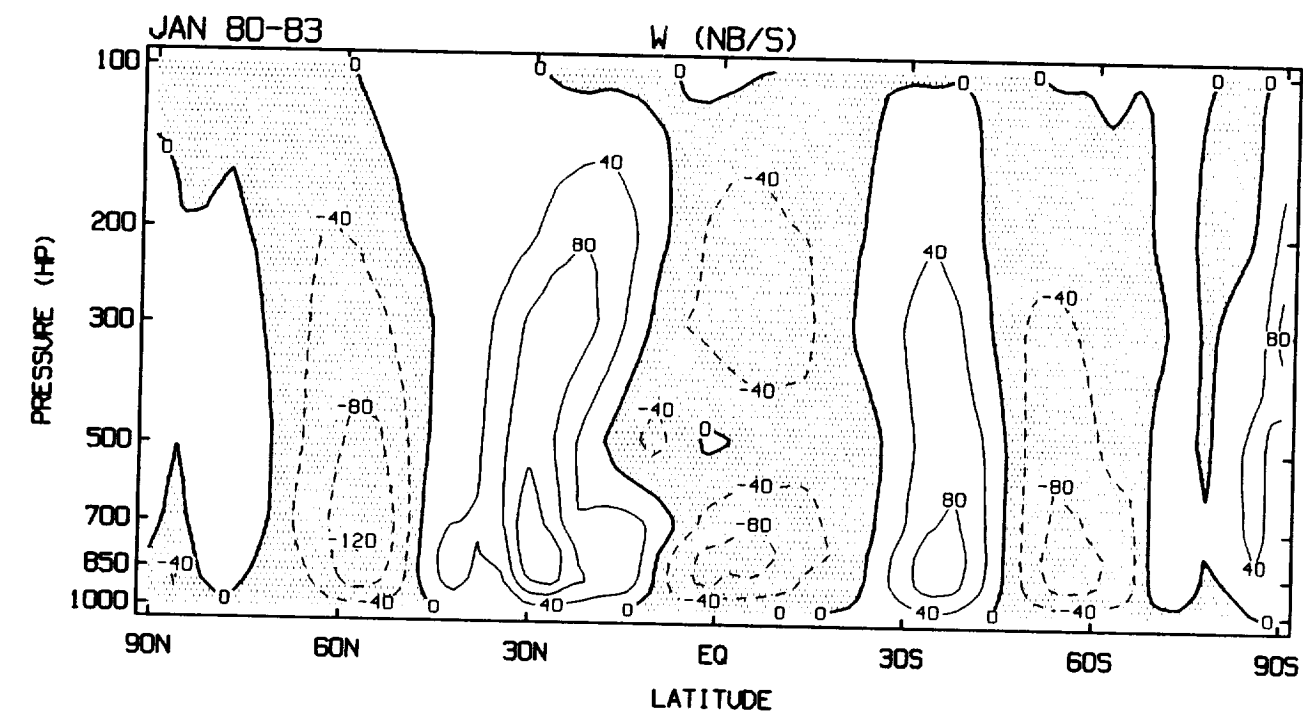


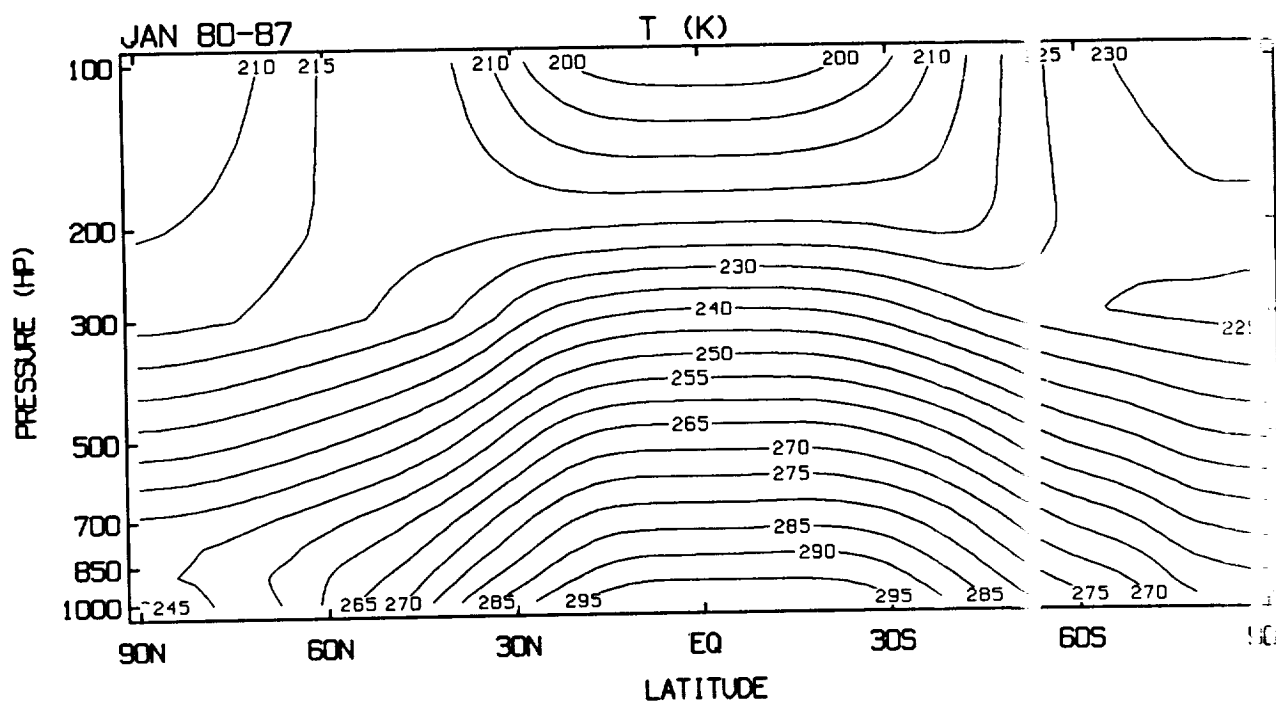
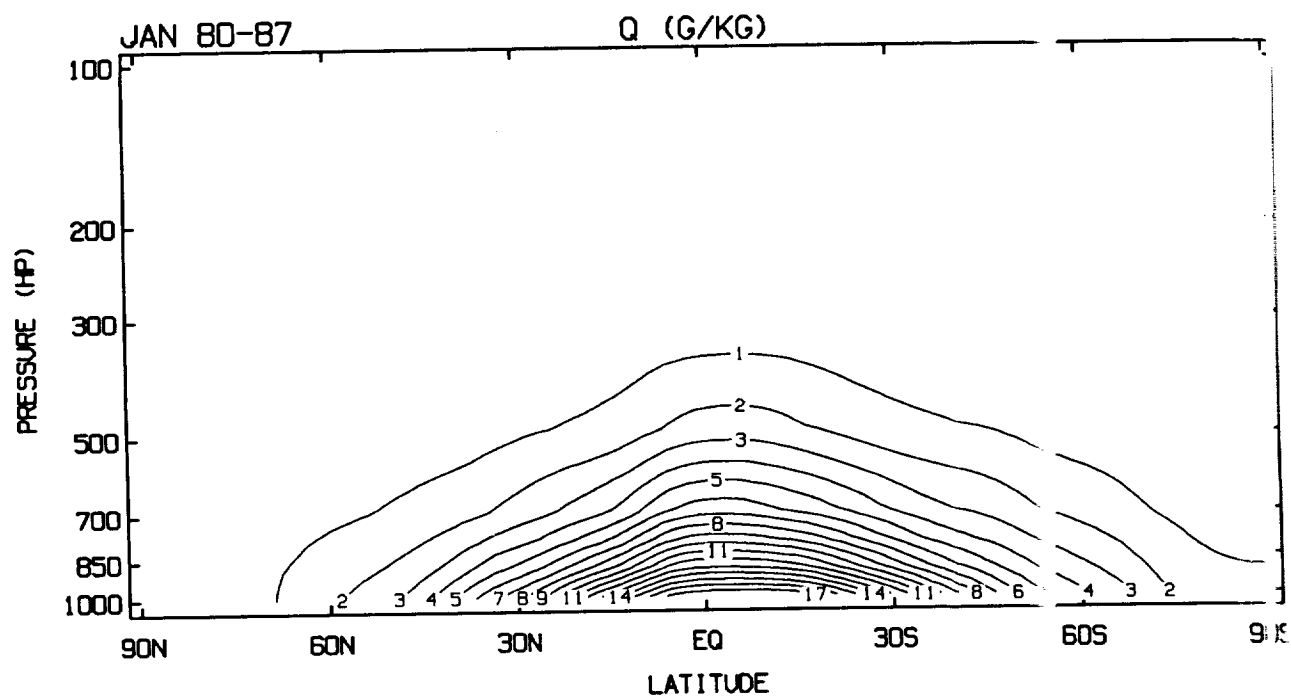




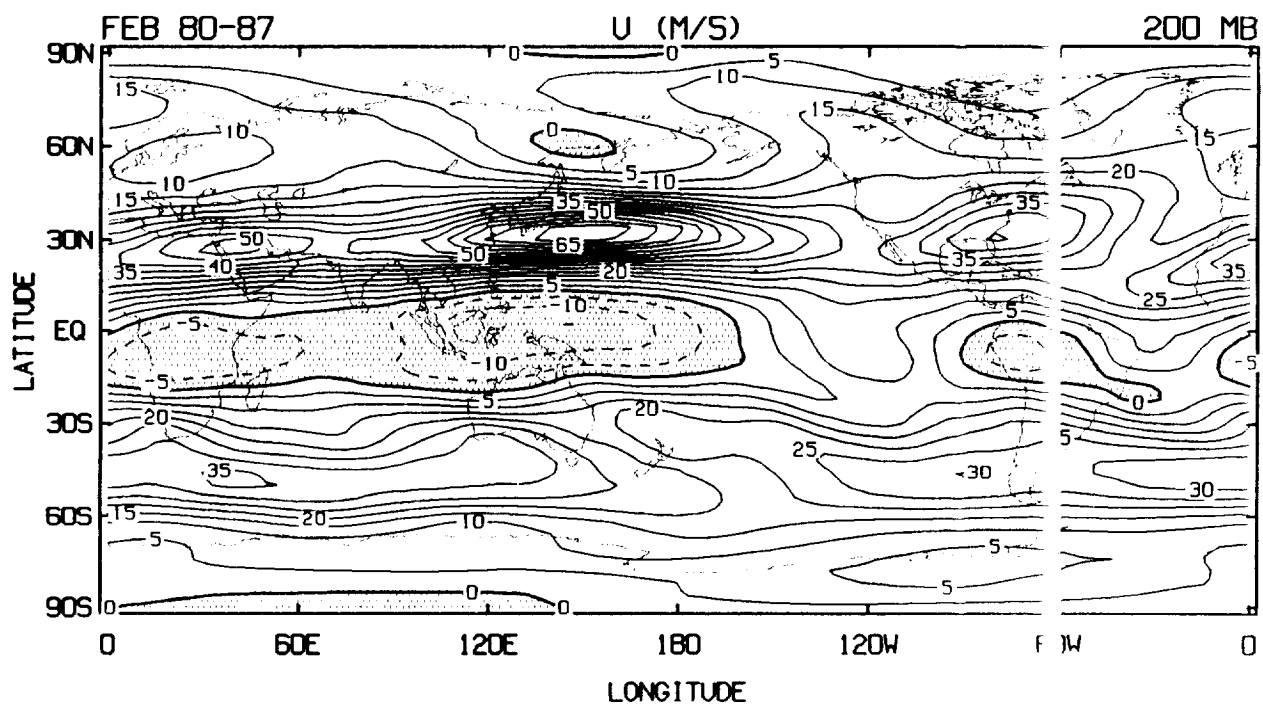
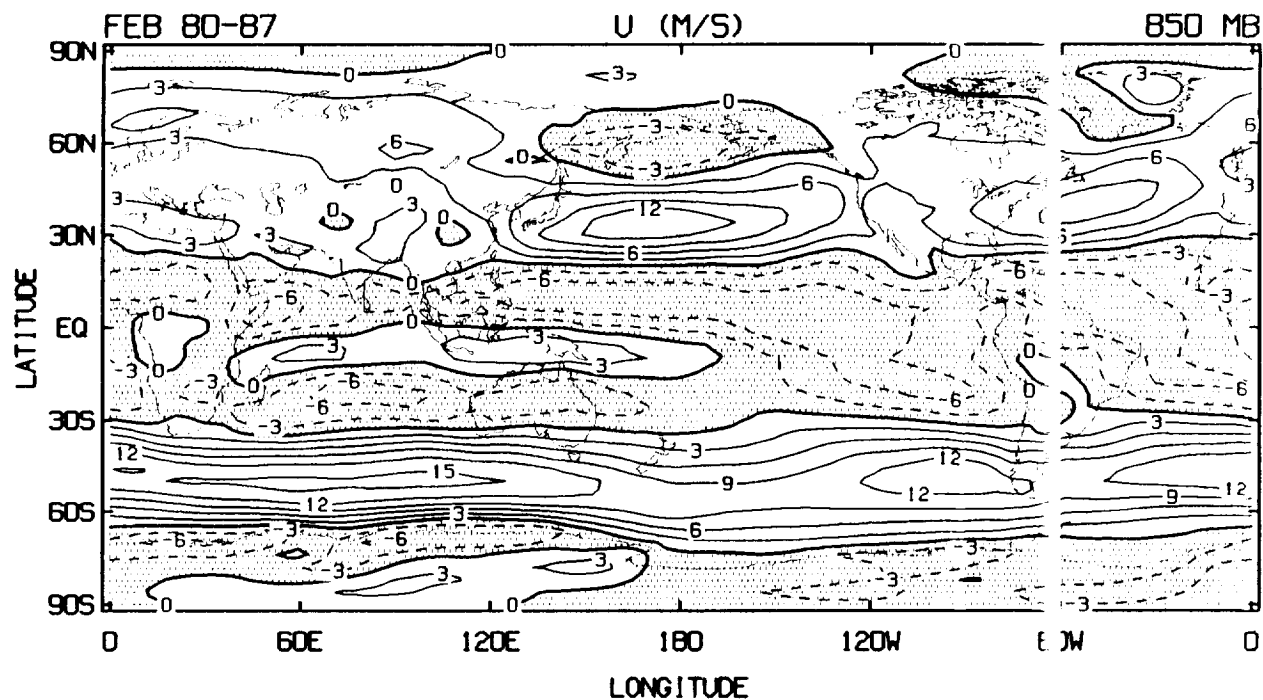


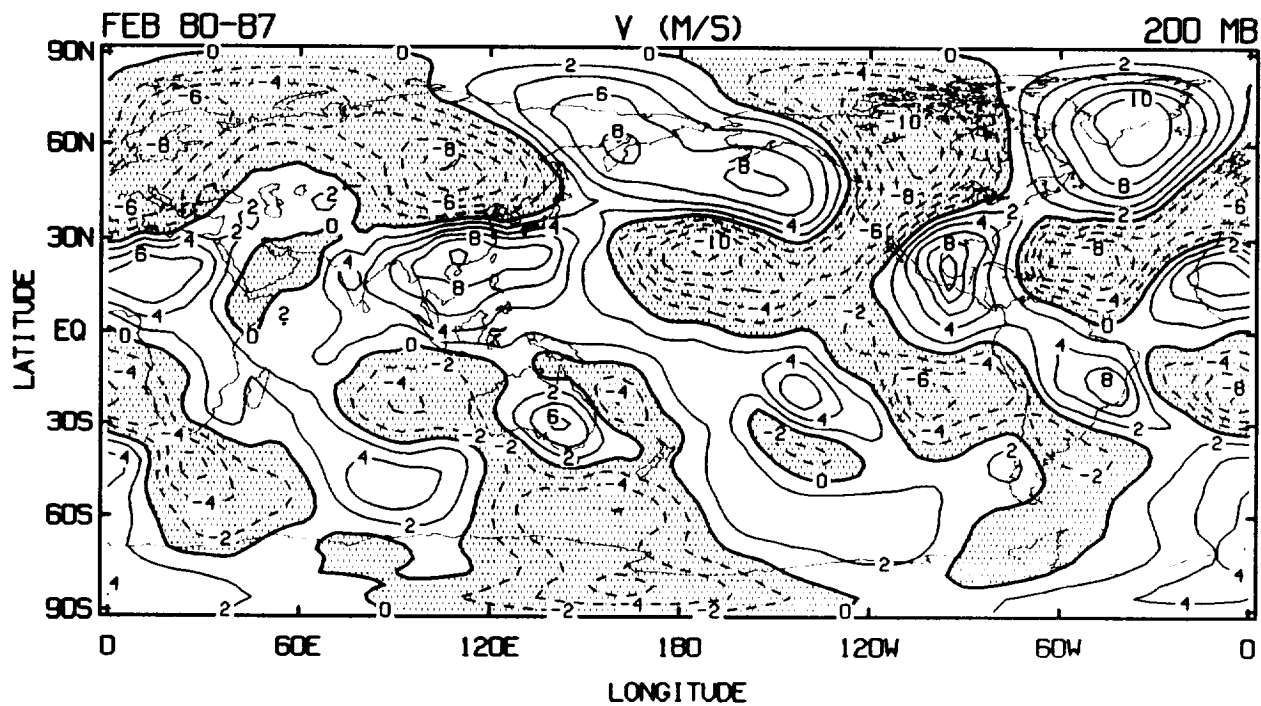
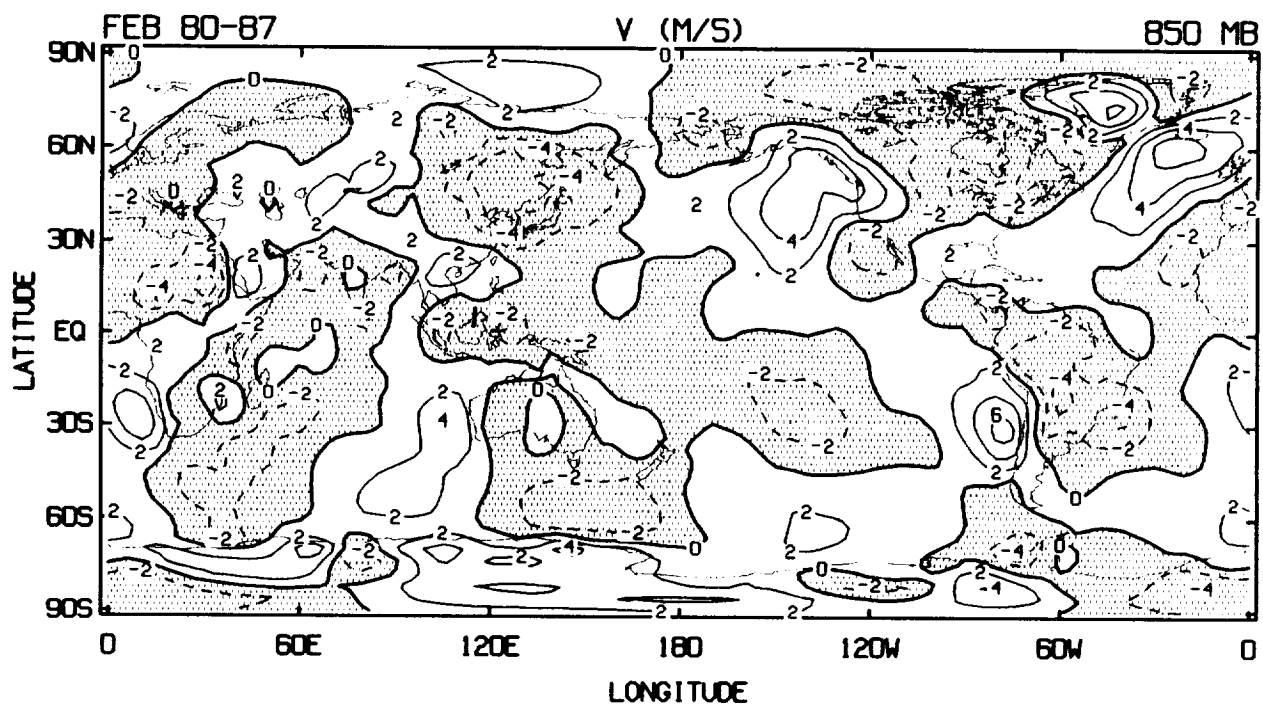


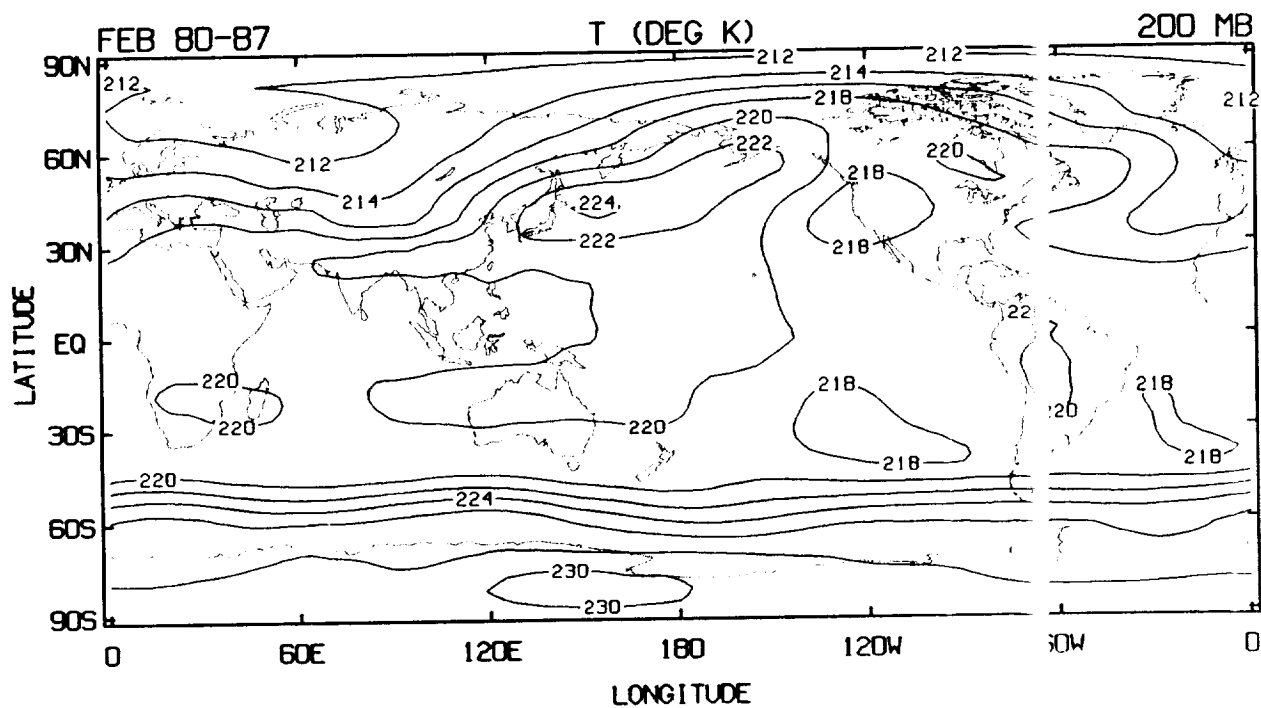
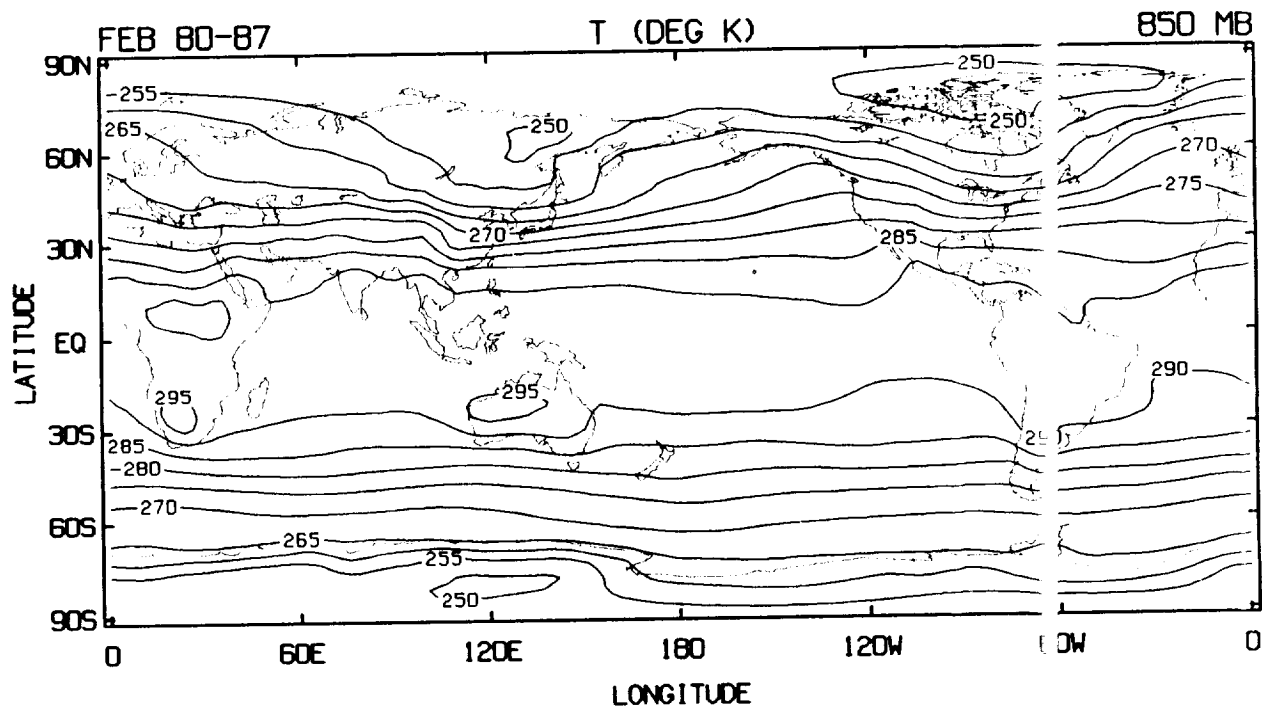


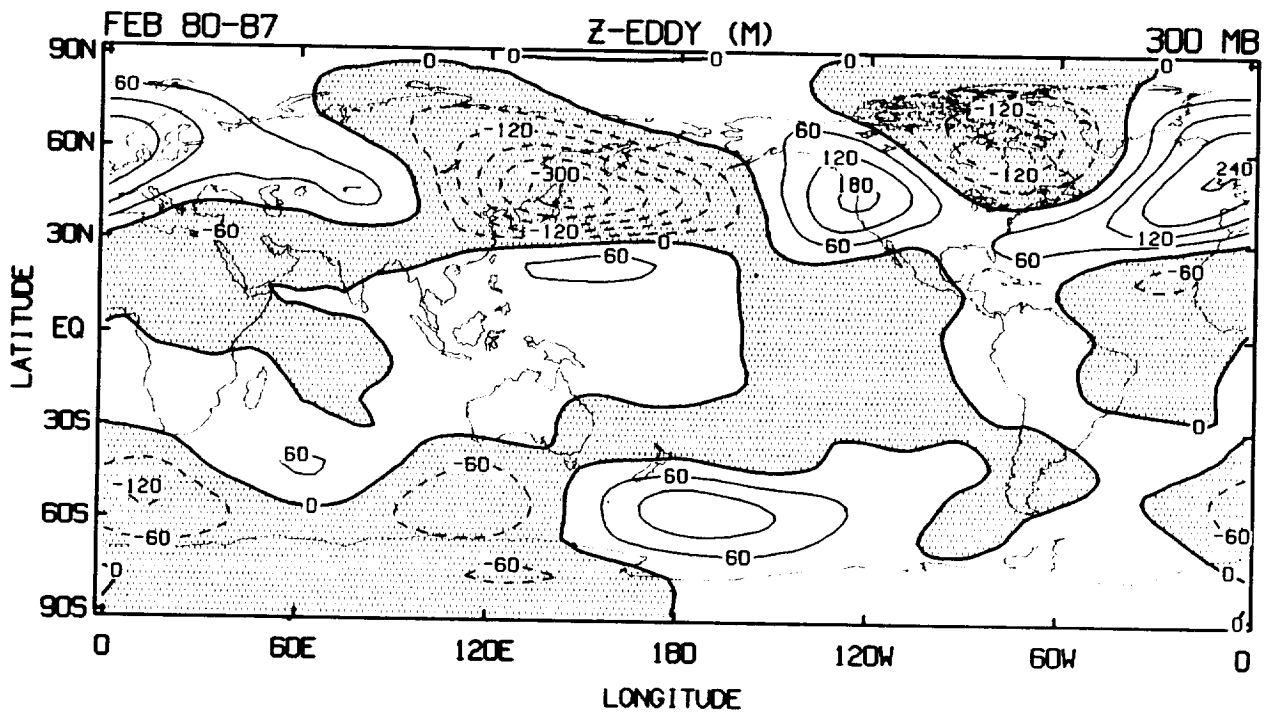
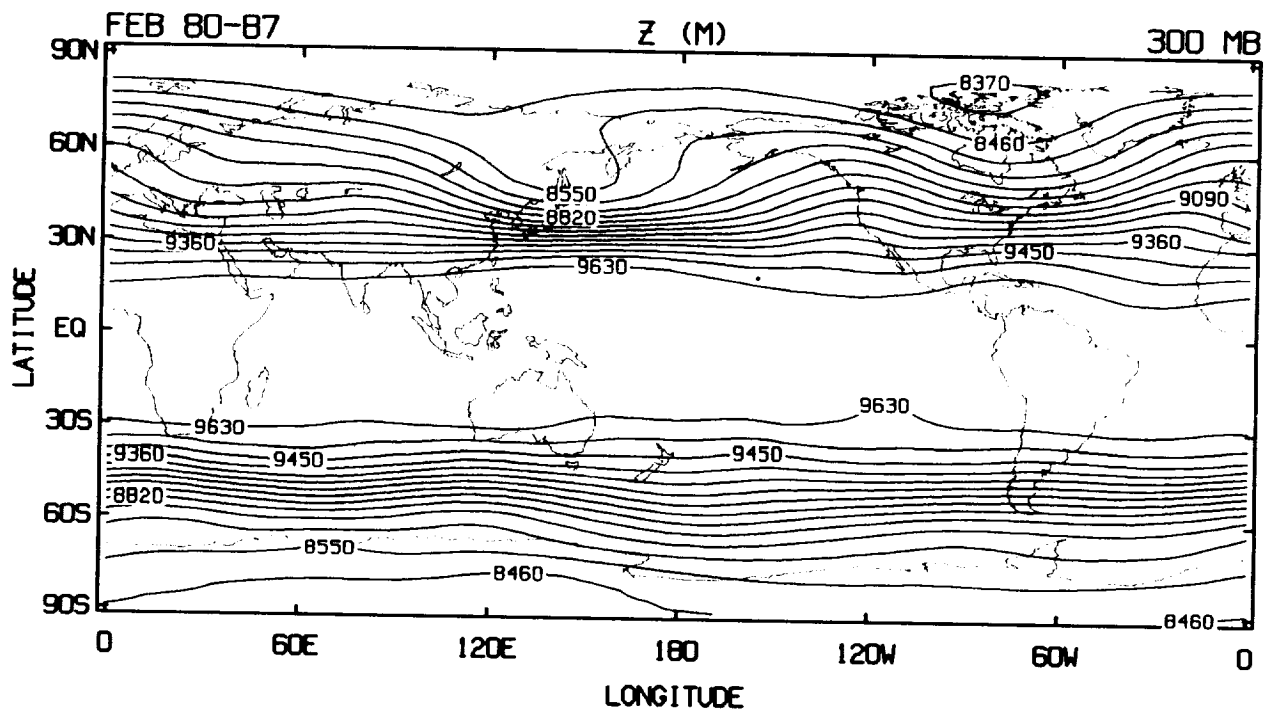


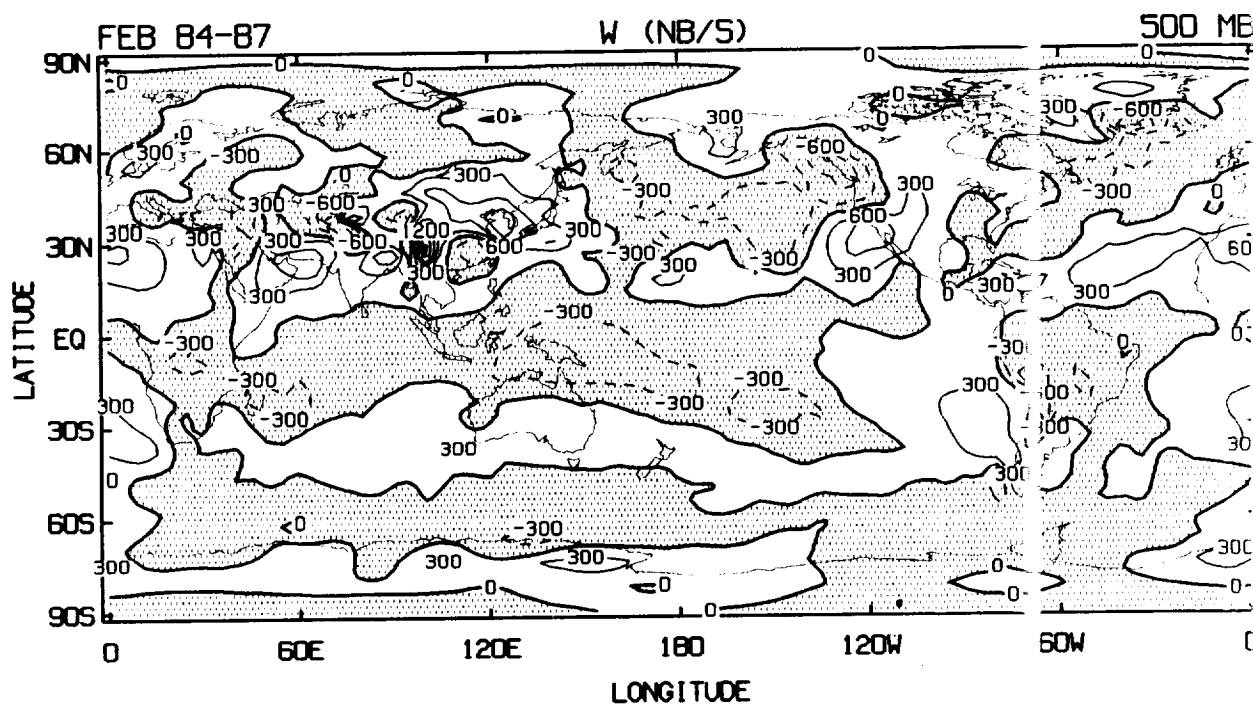
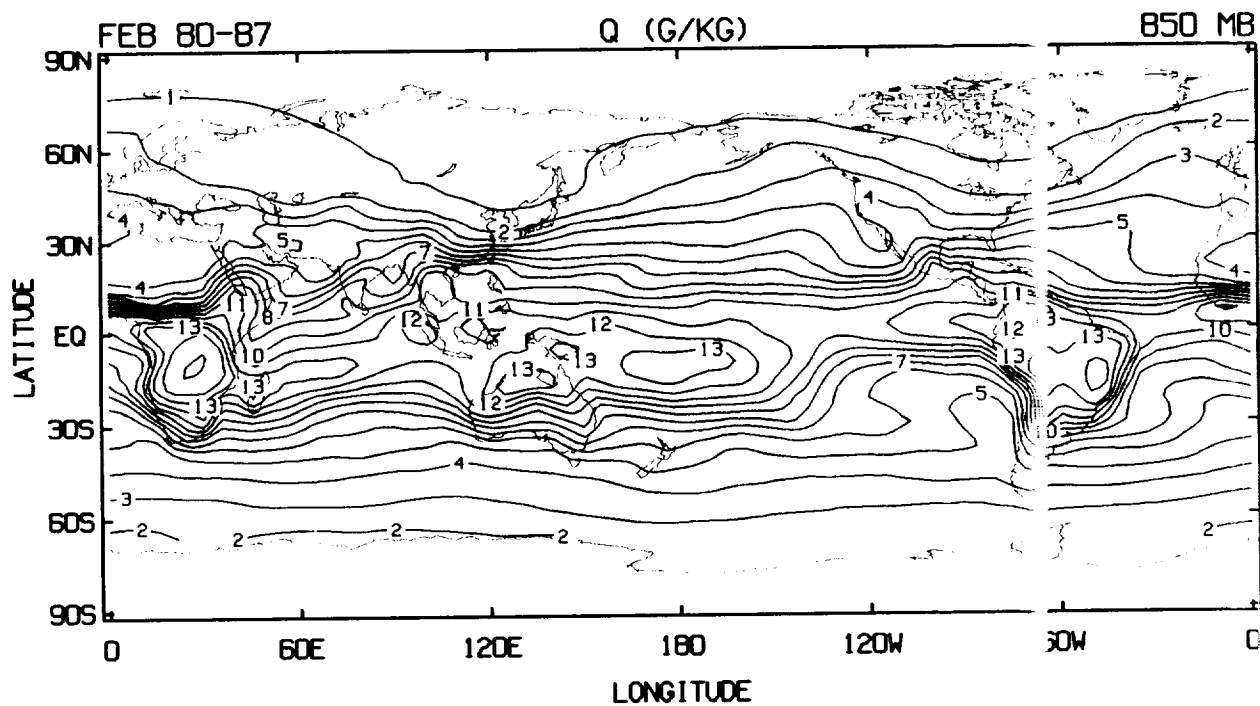
FEBRUARY

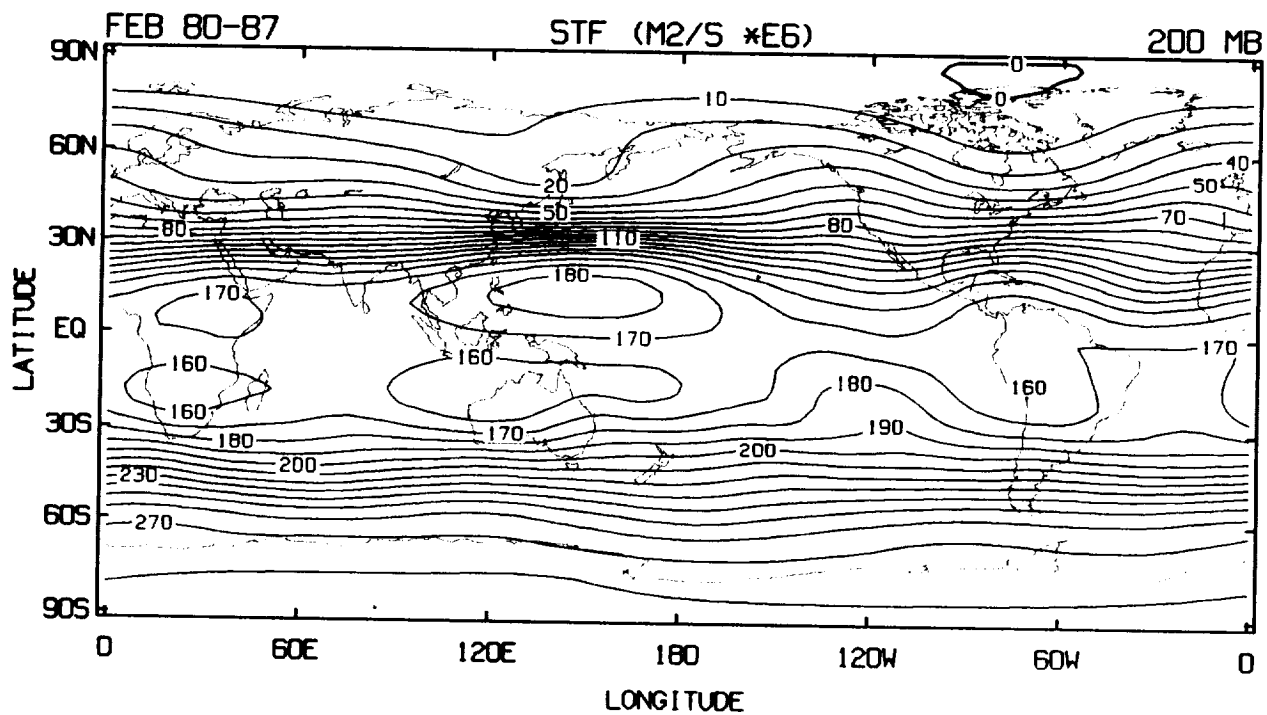
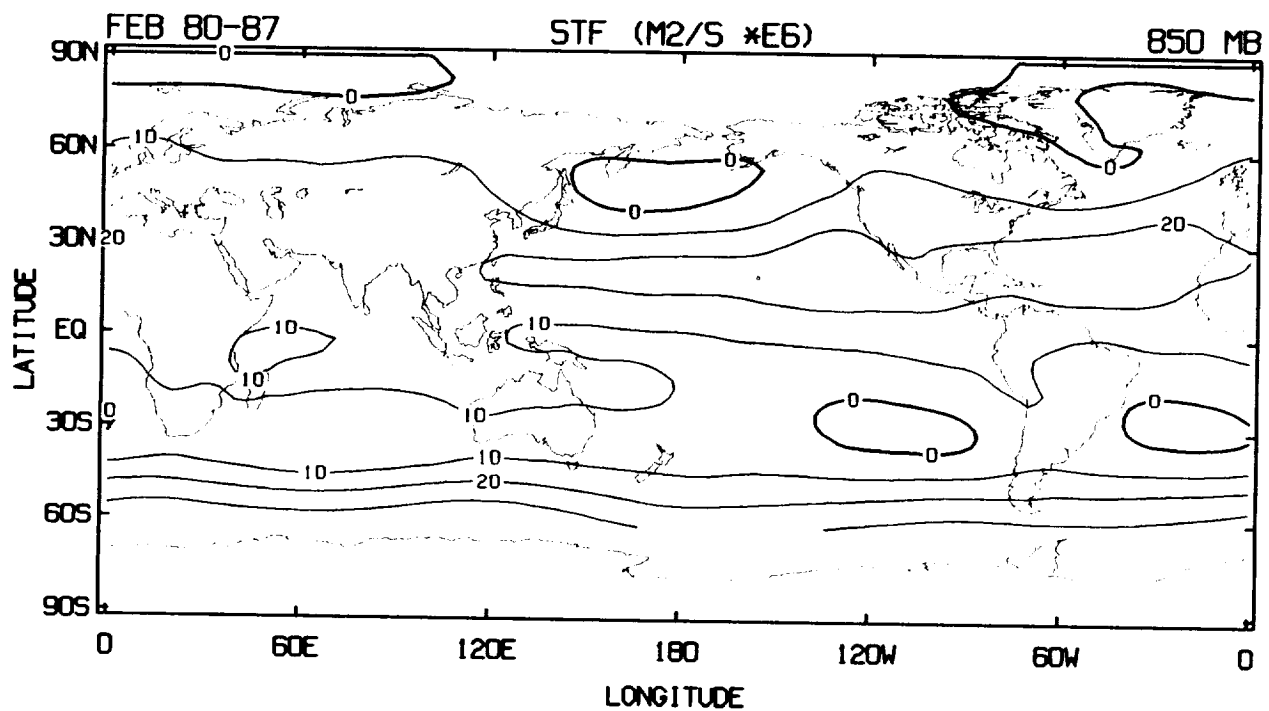


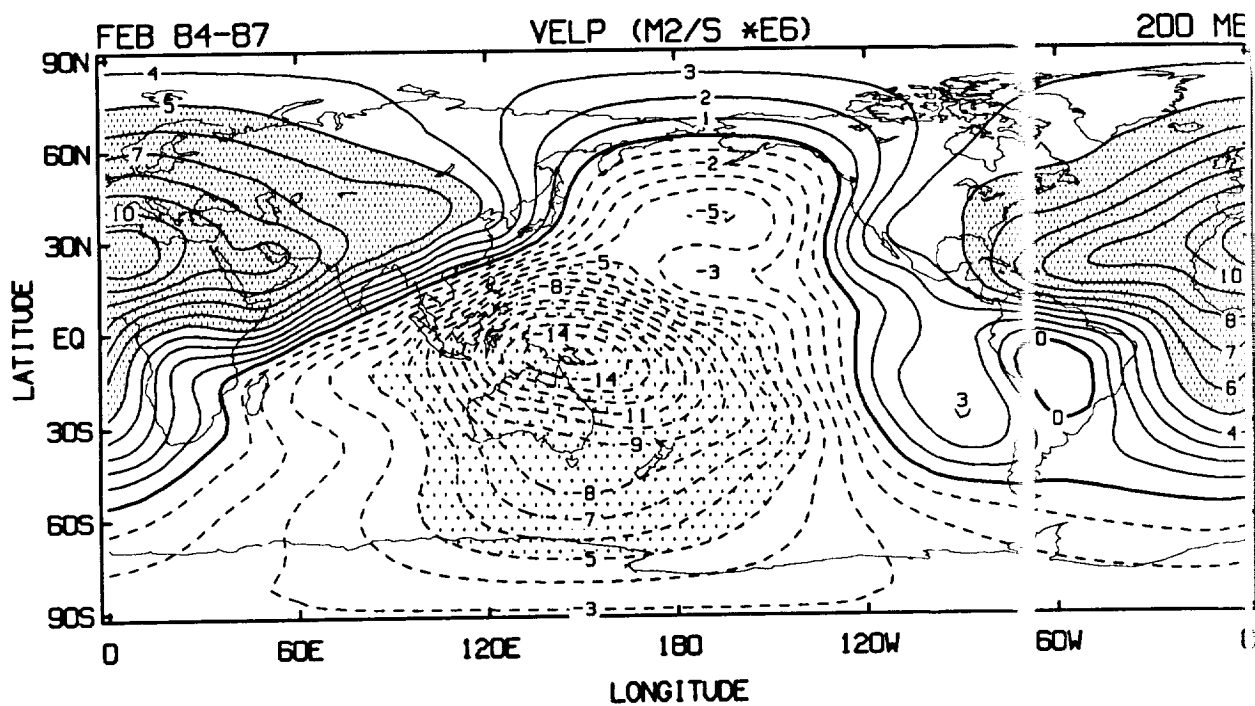
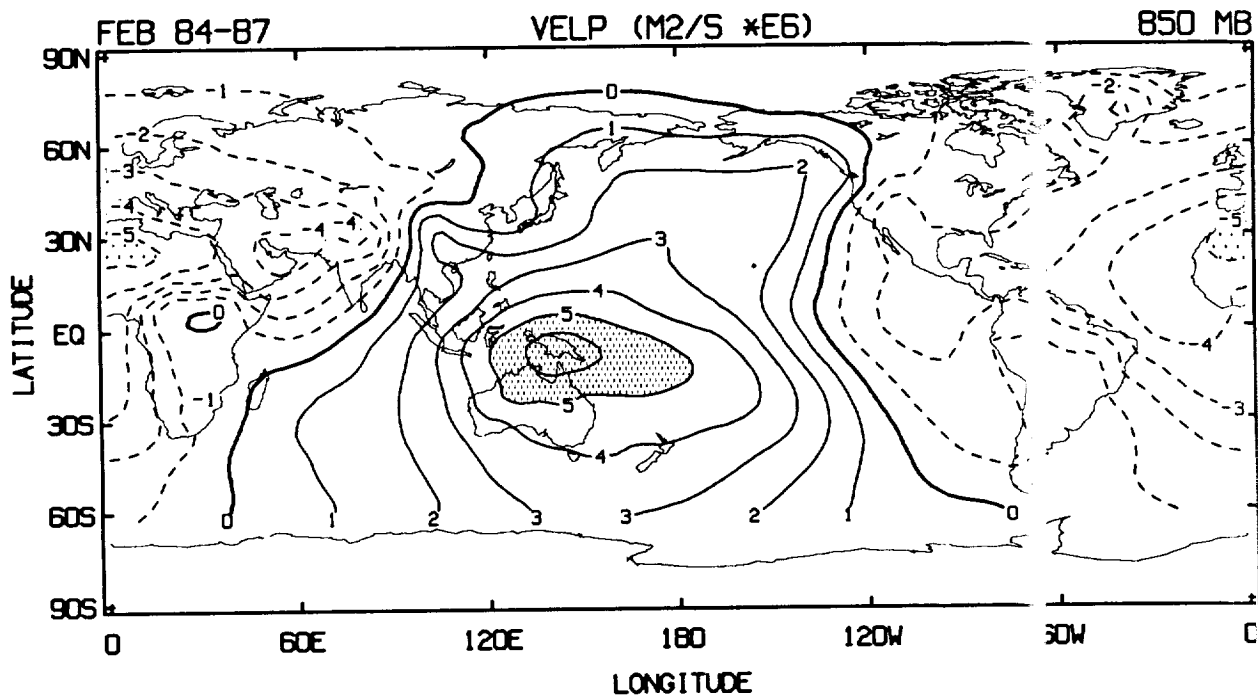


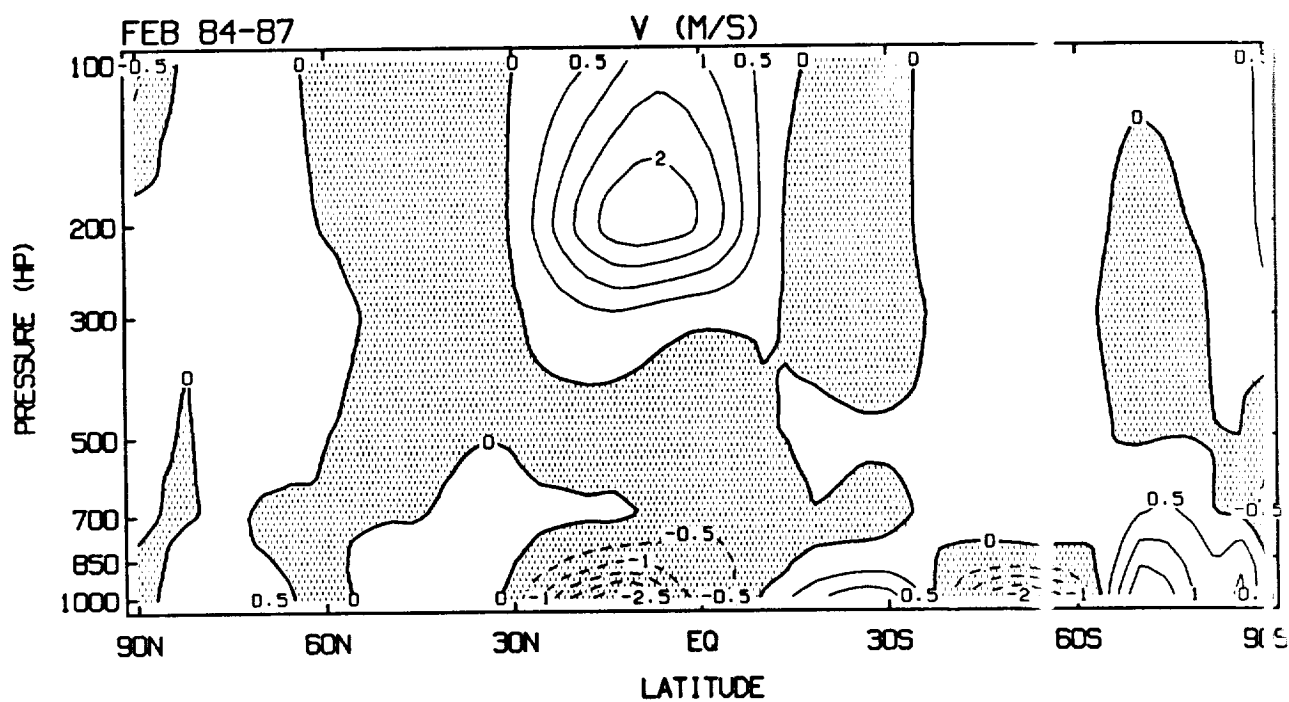
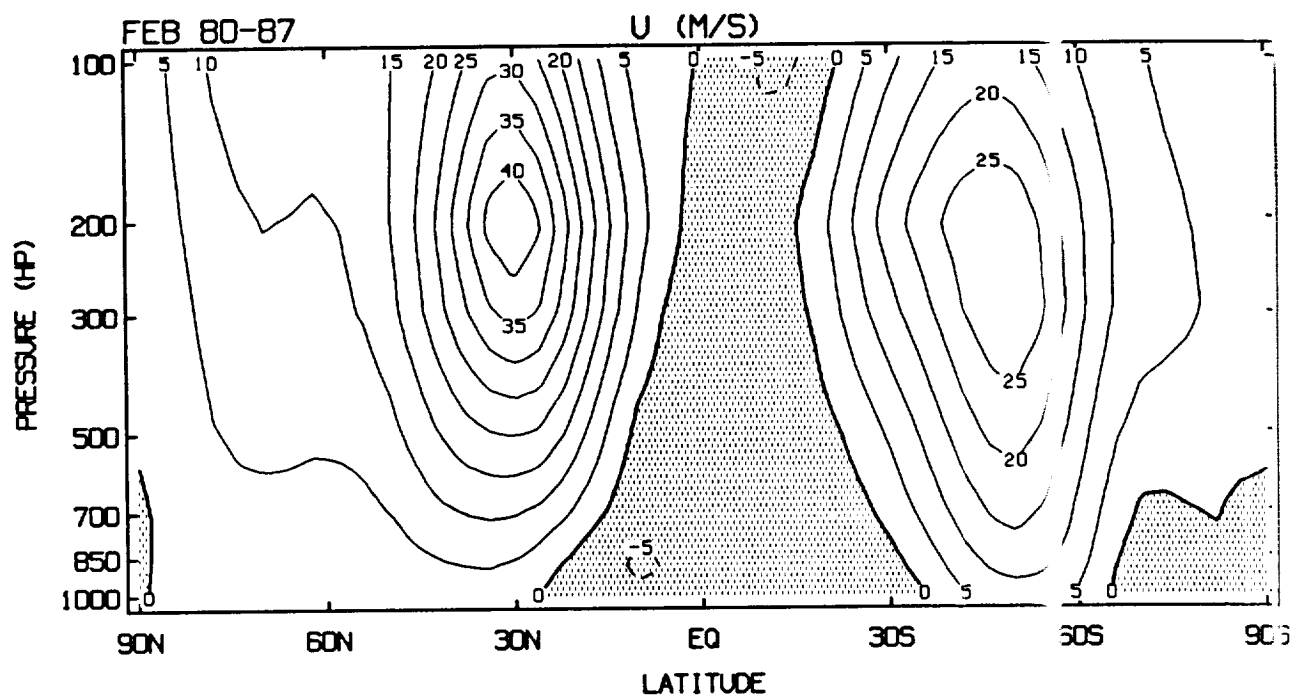


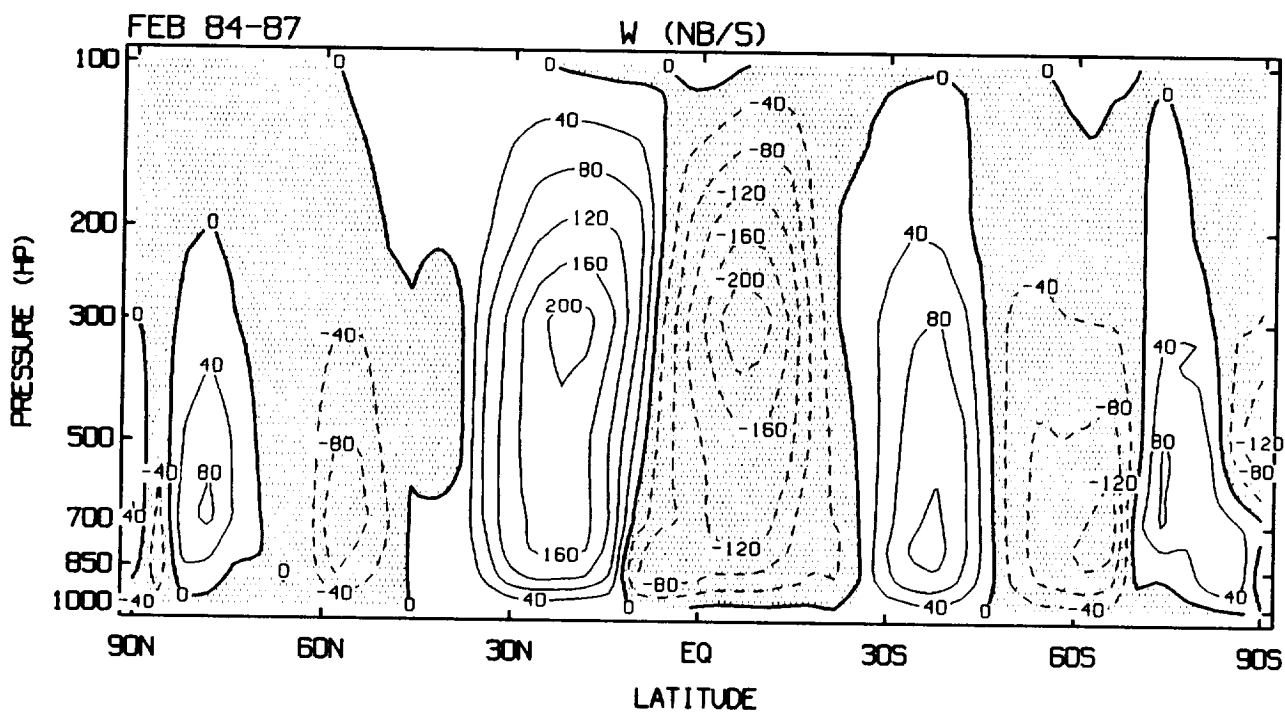
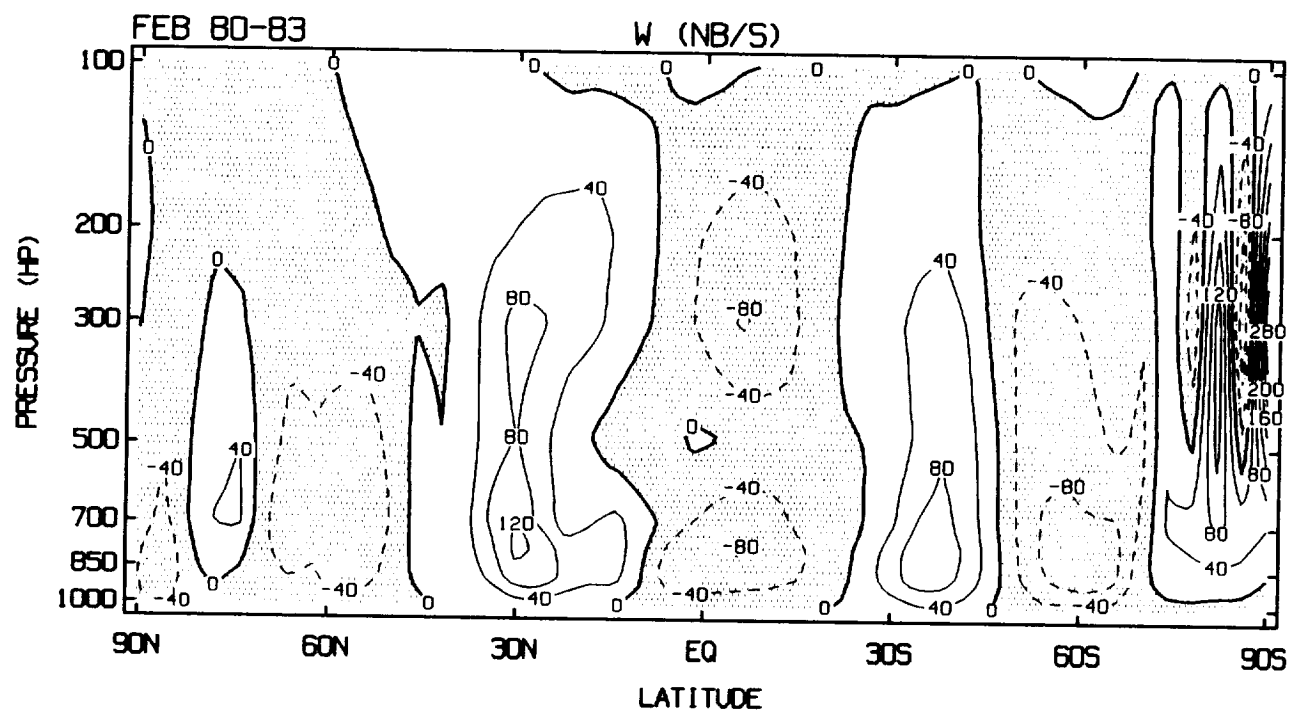


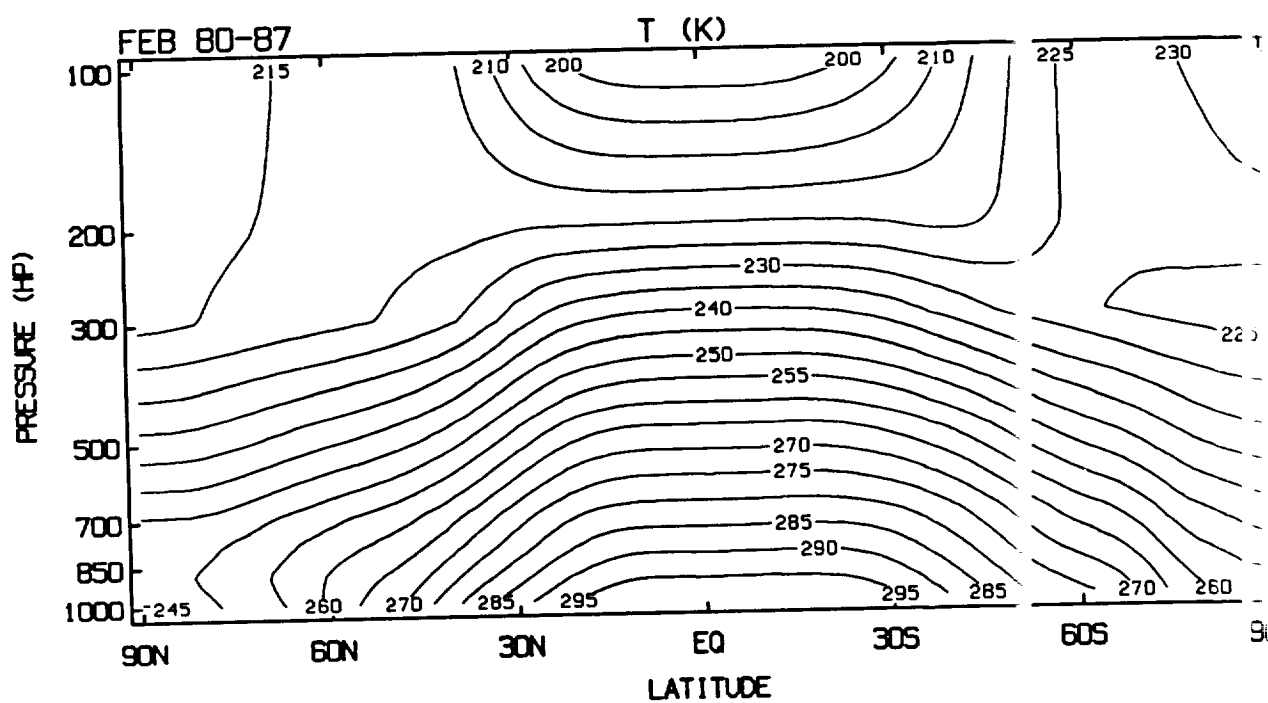
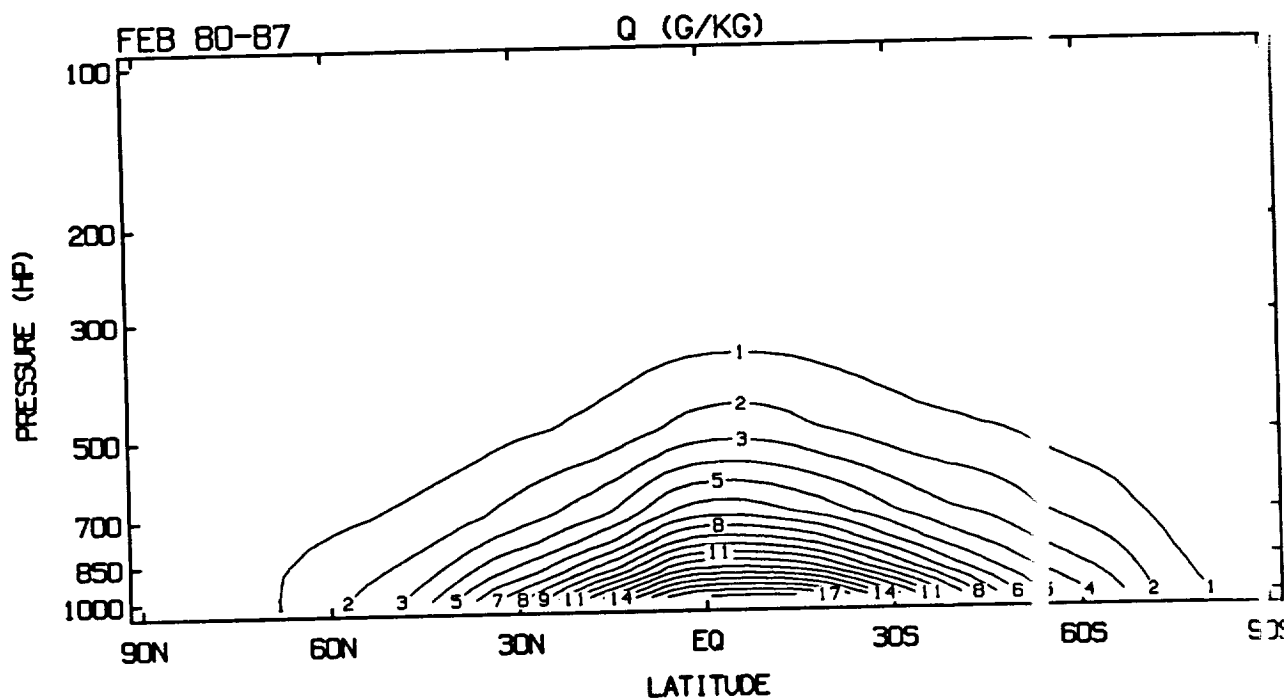




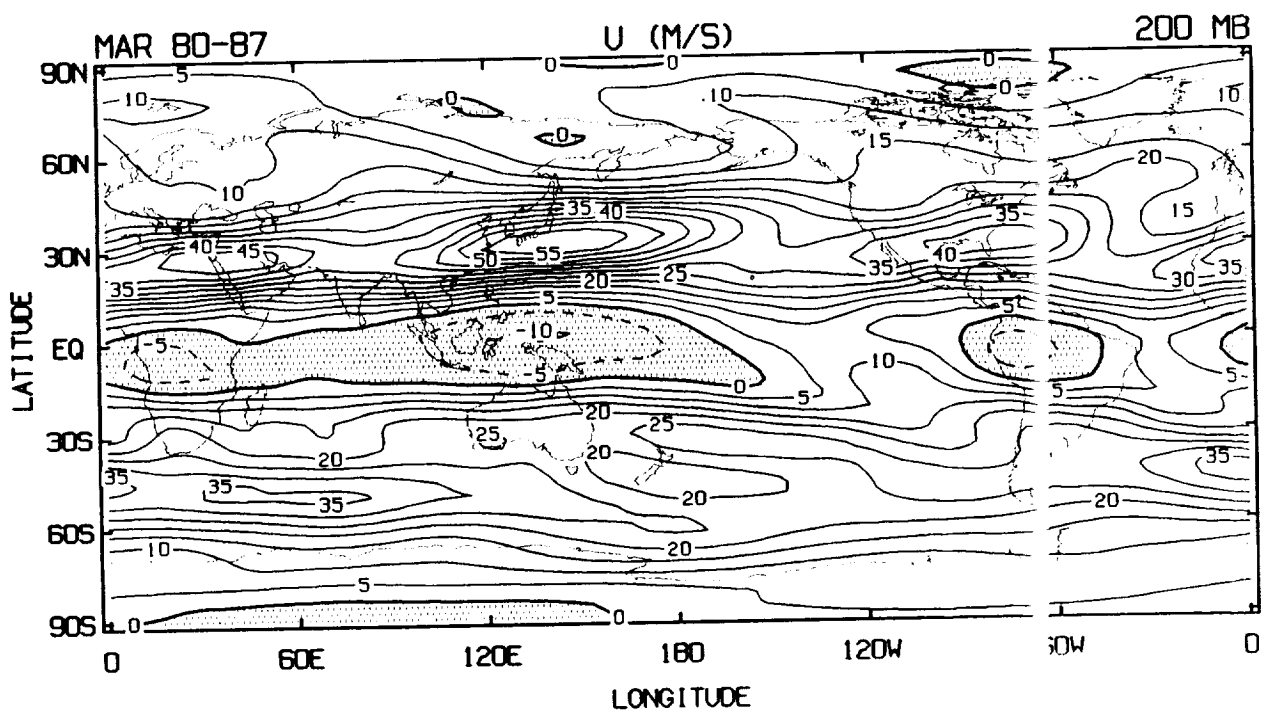
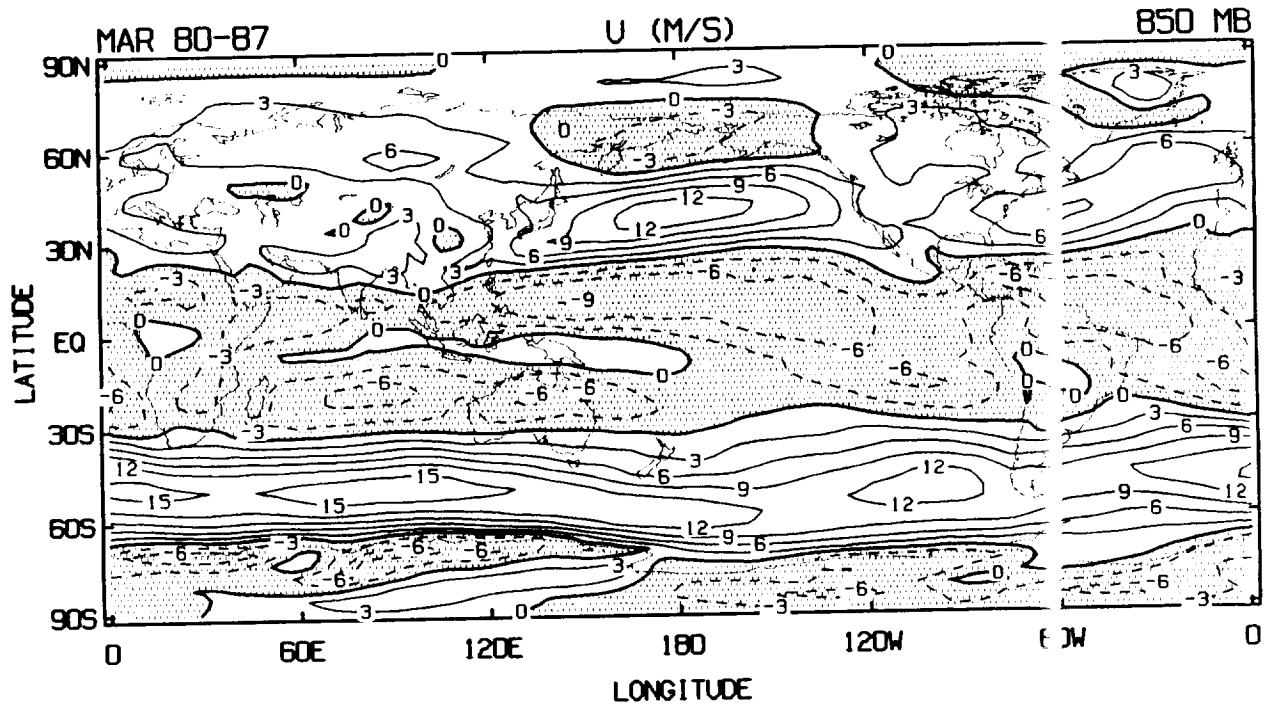


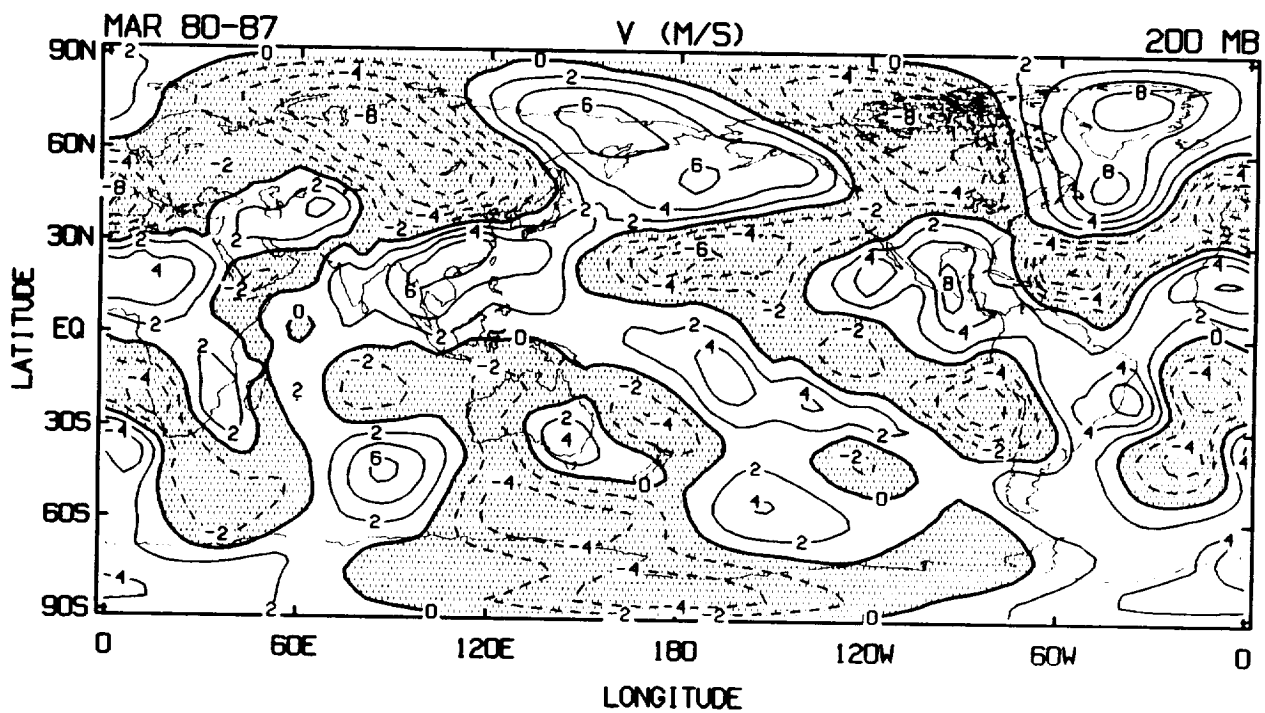
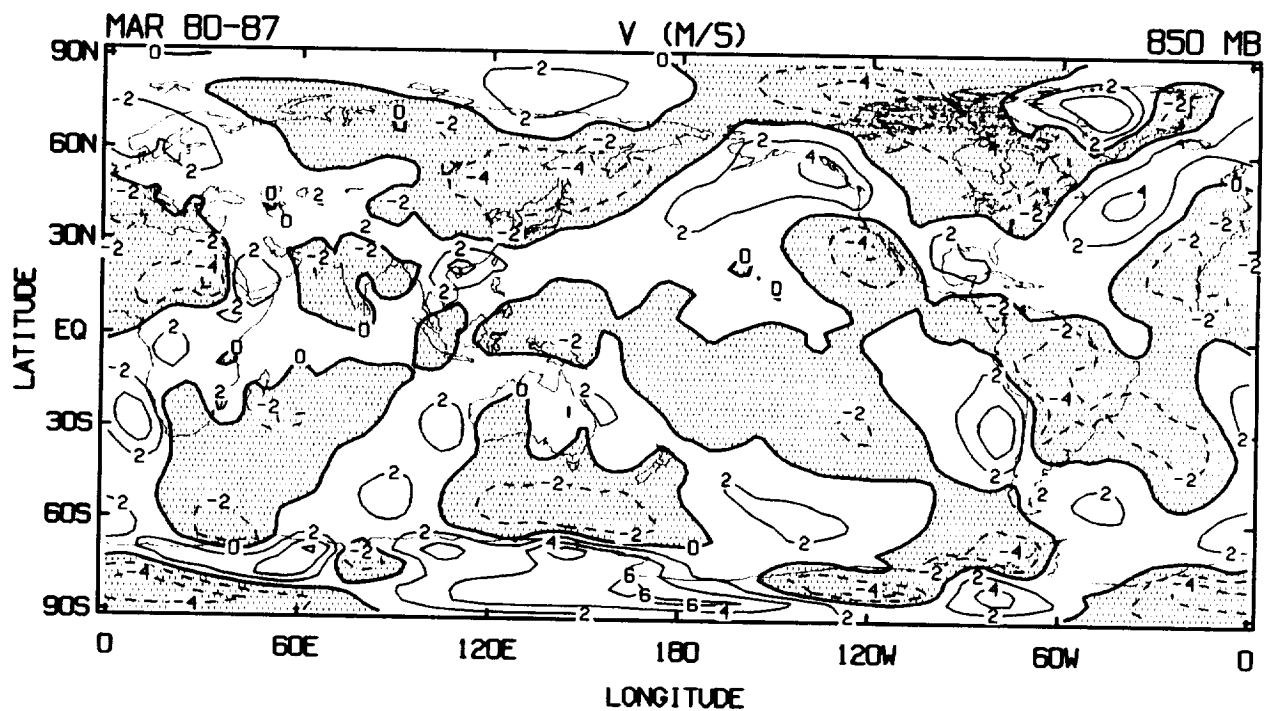


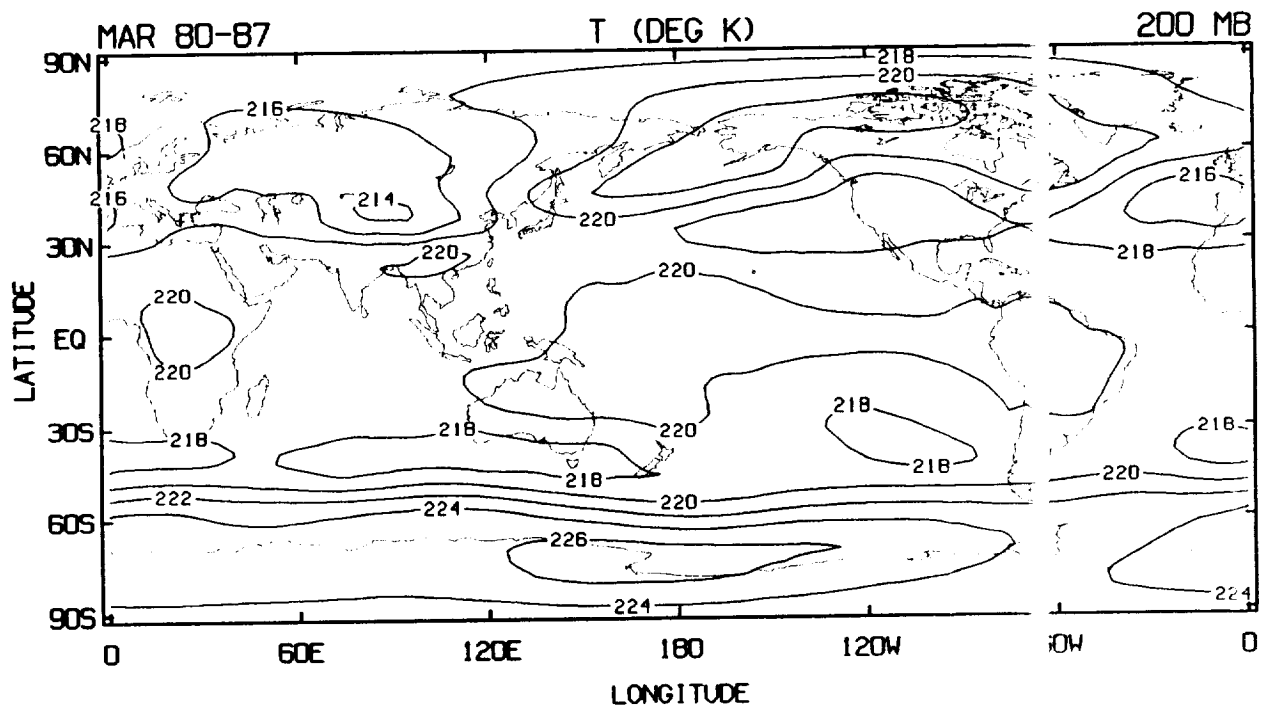
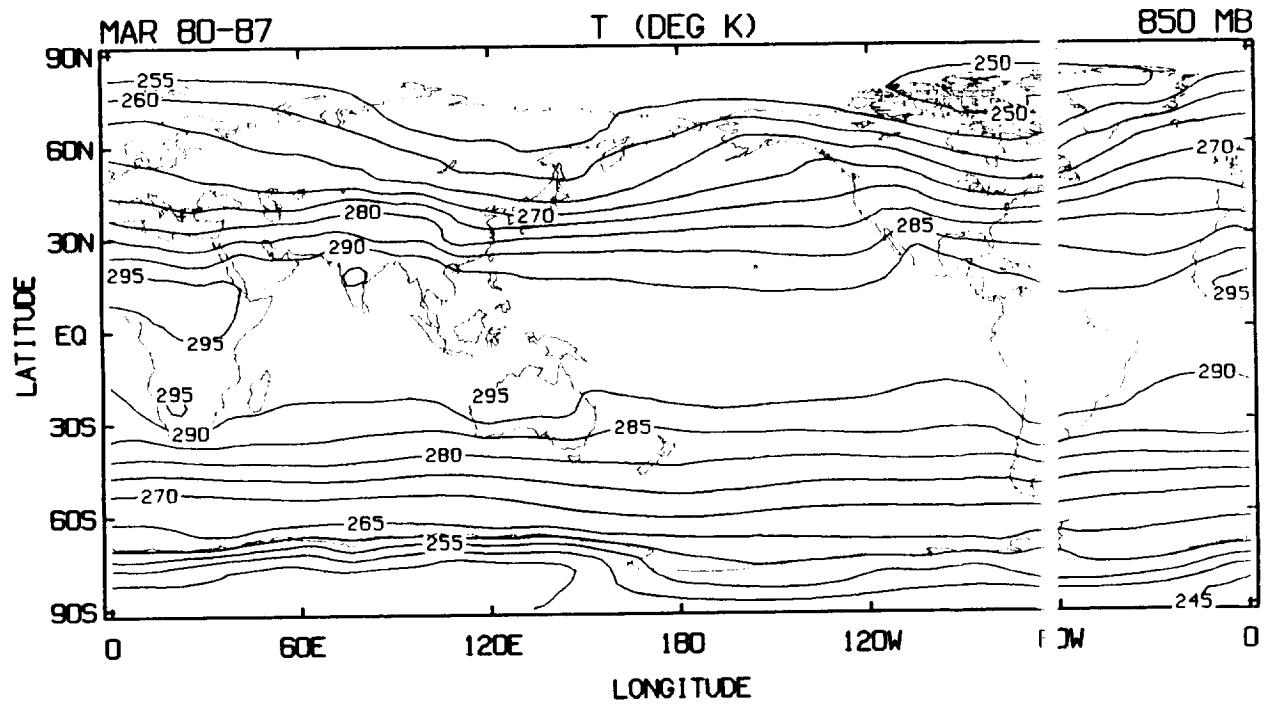


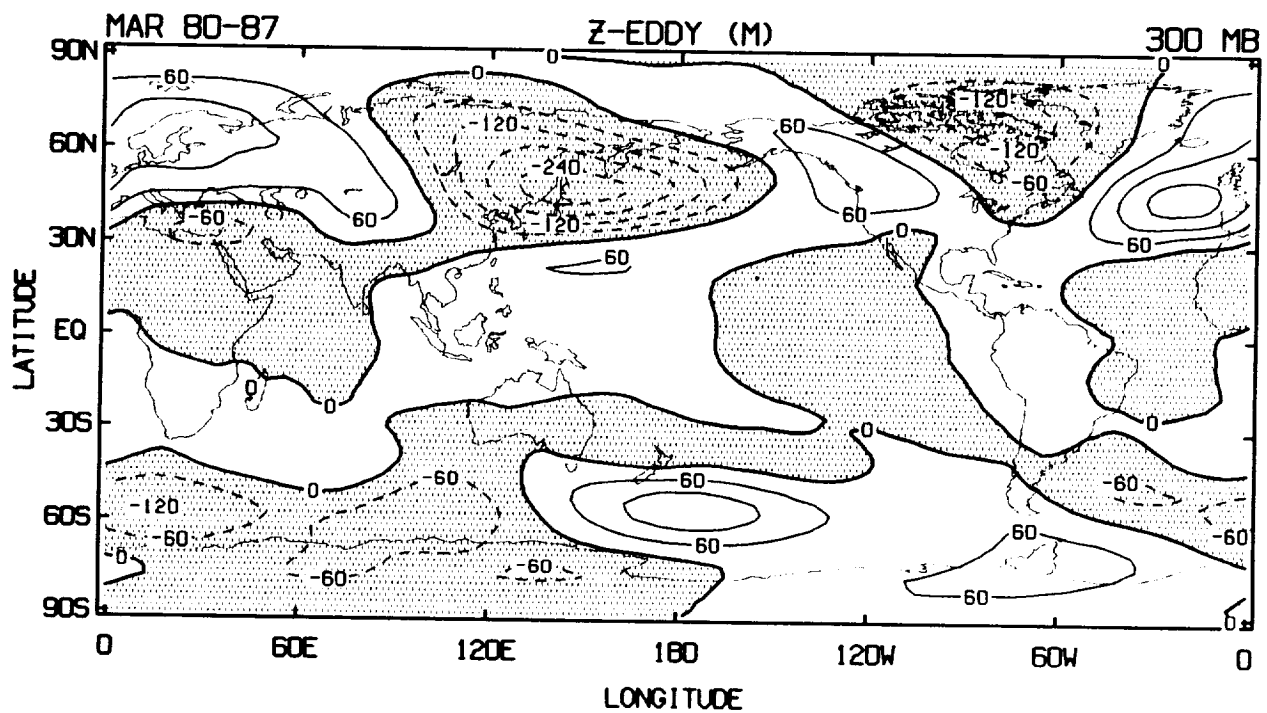
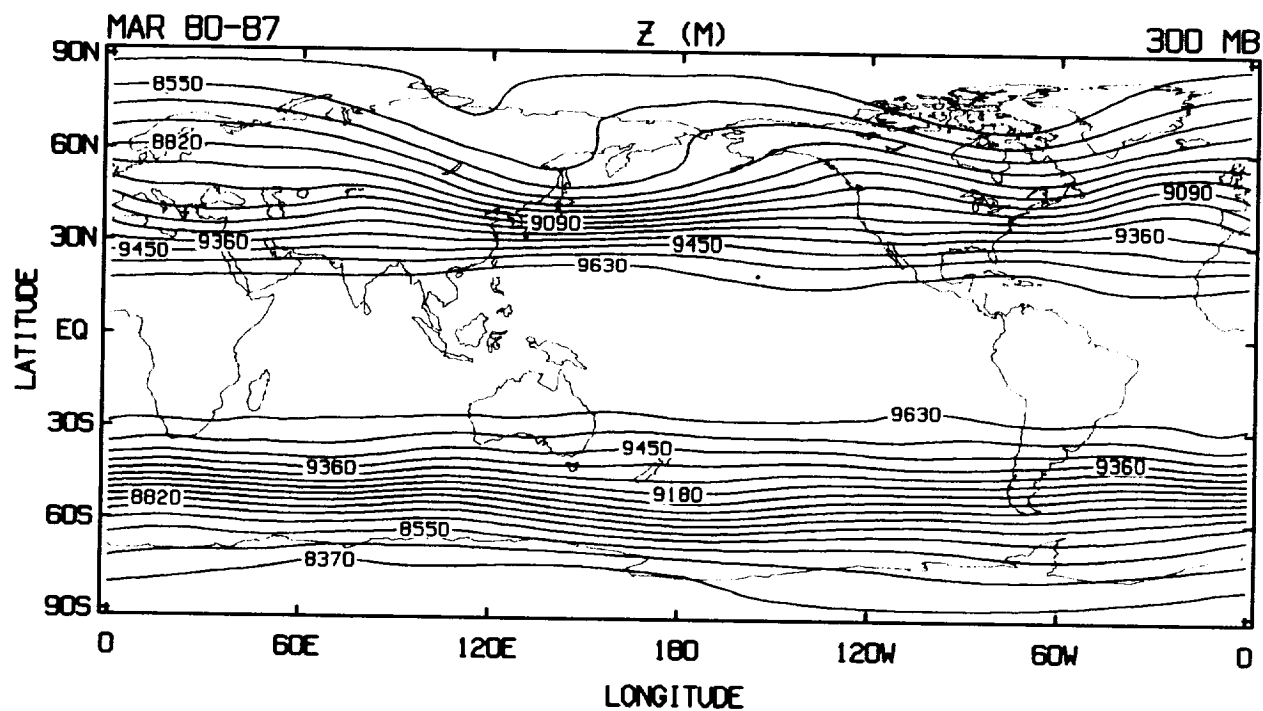


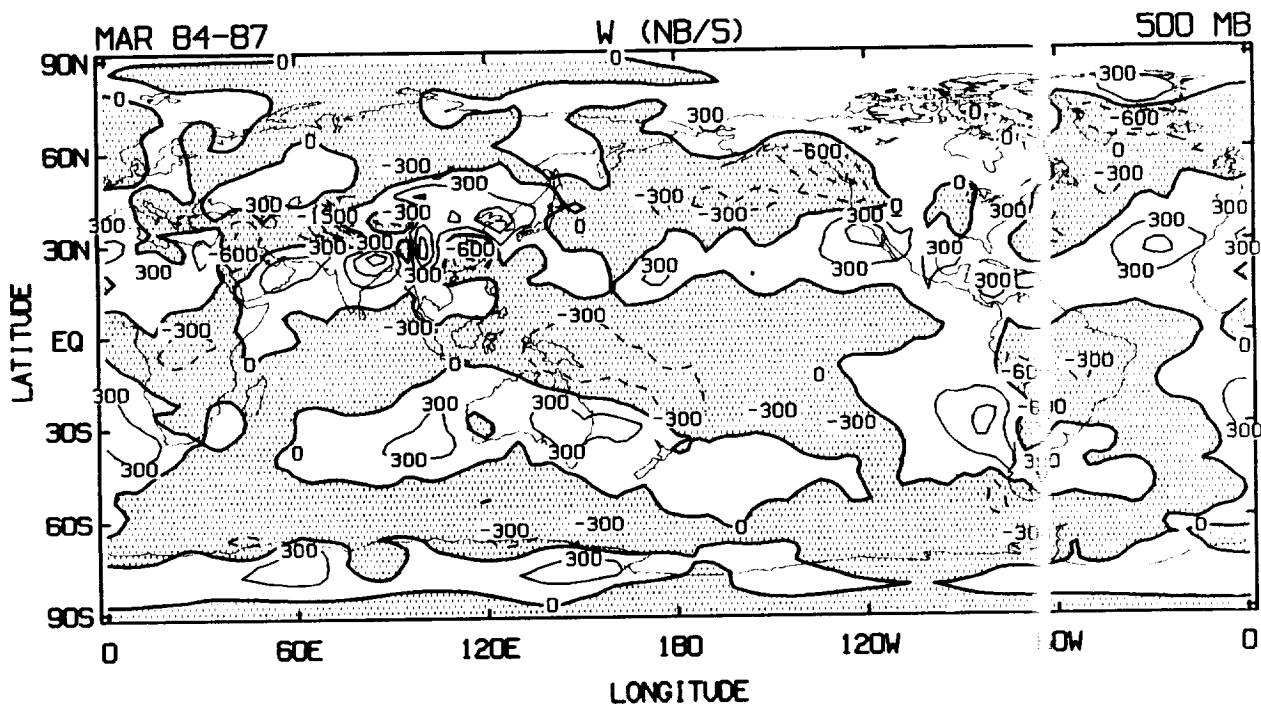
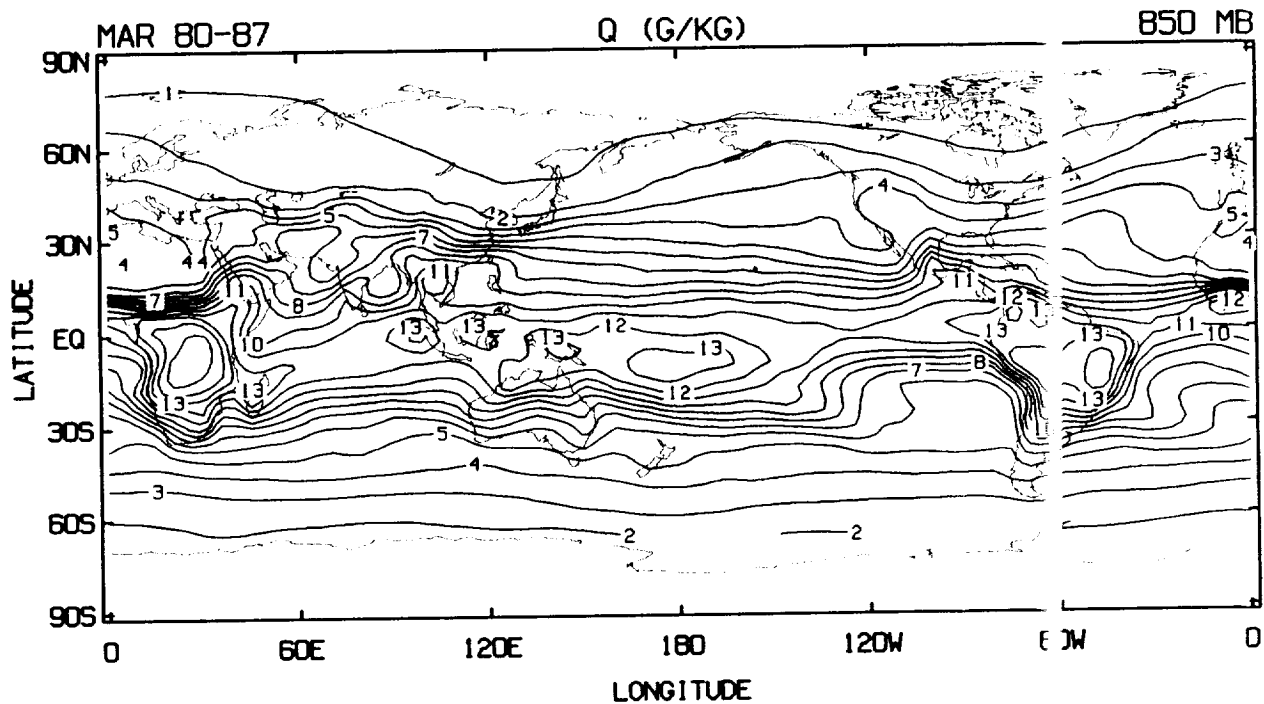
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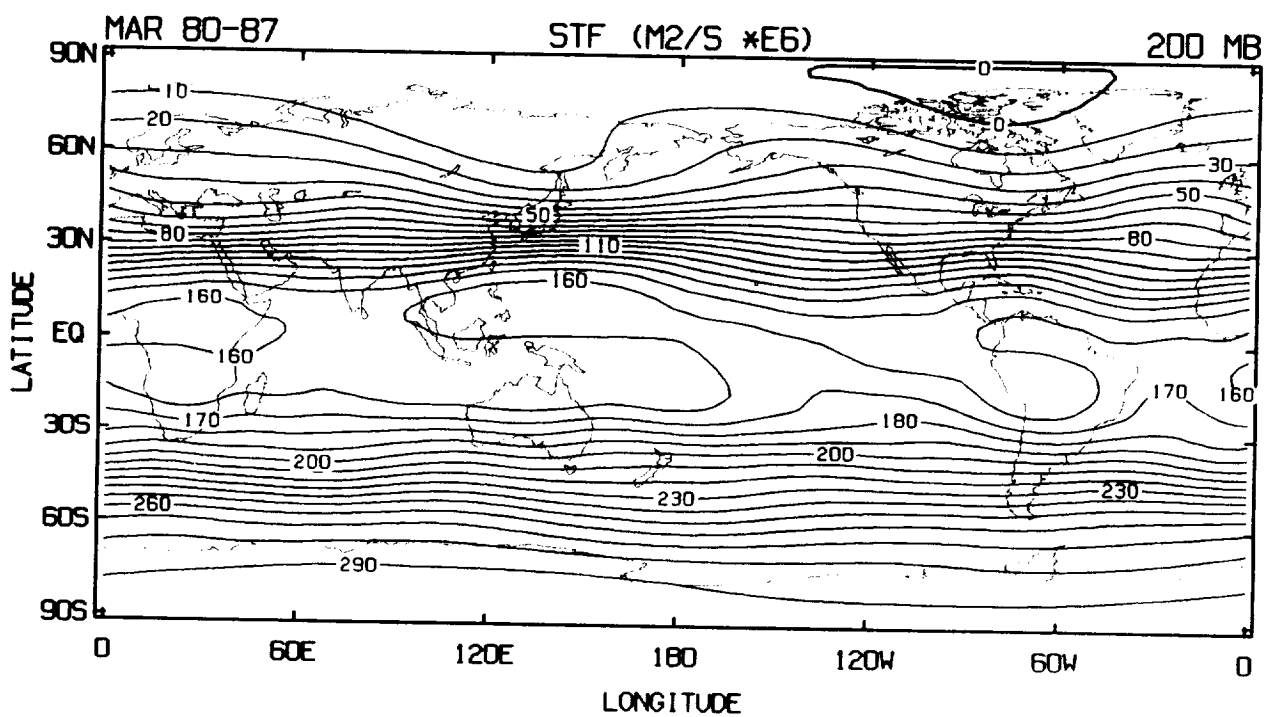
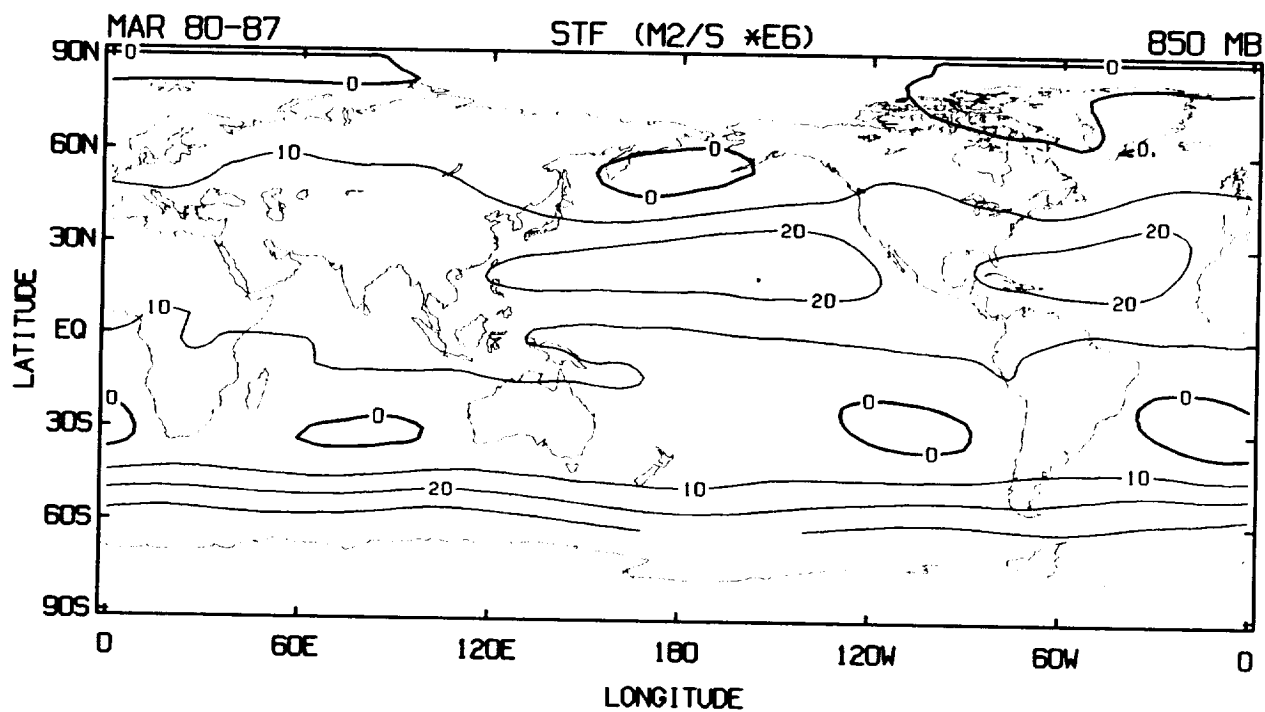


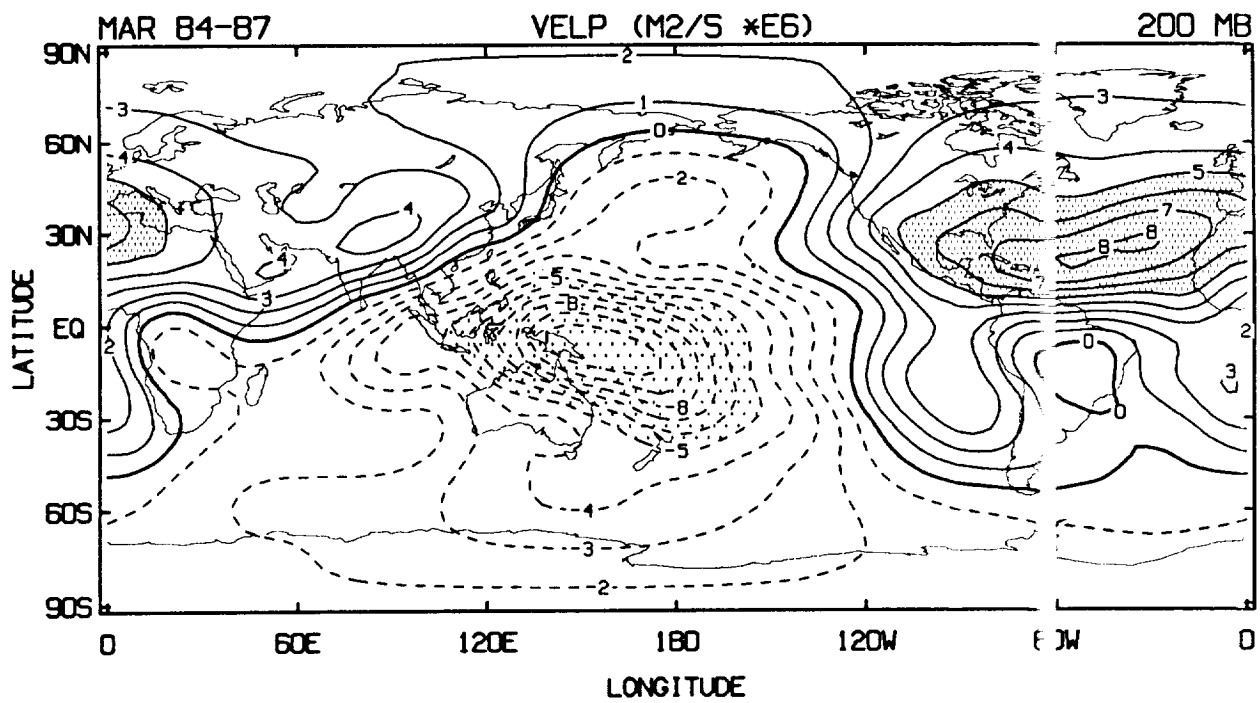
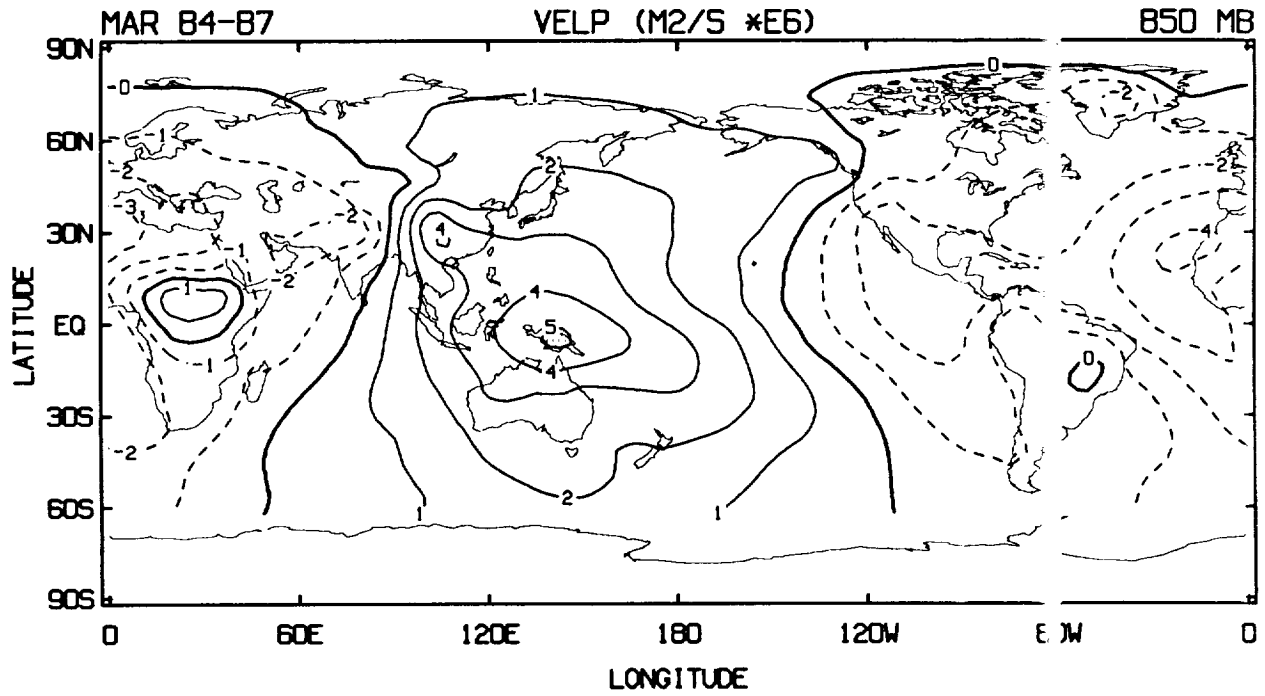


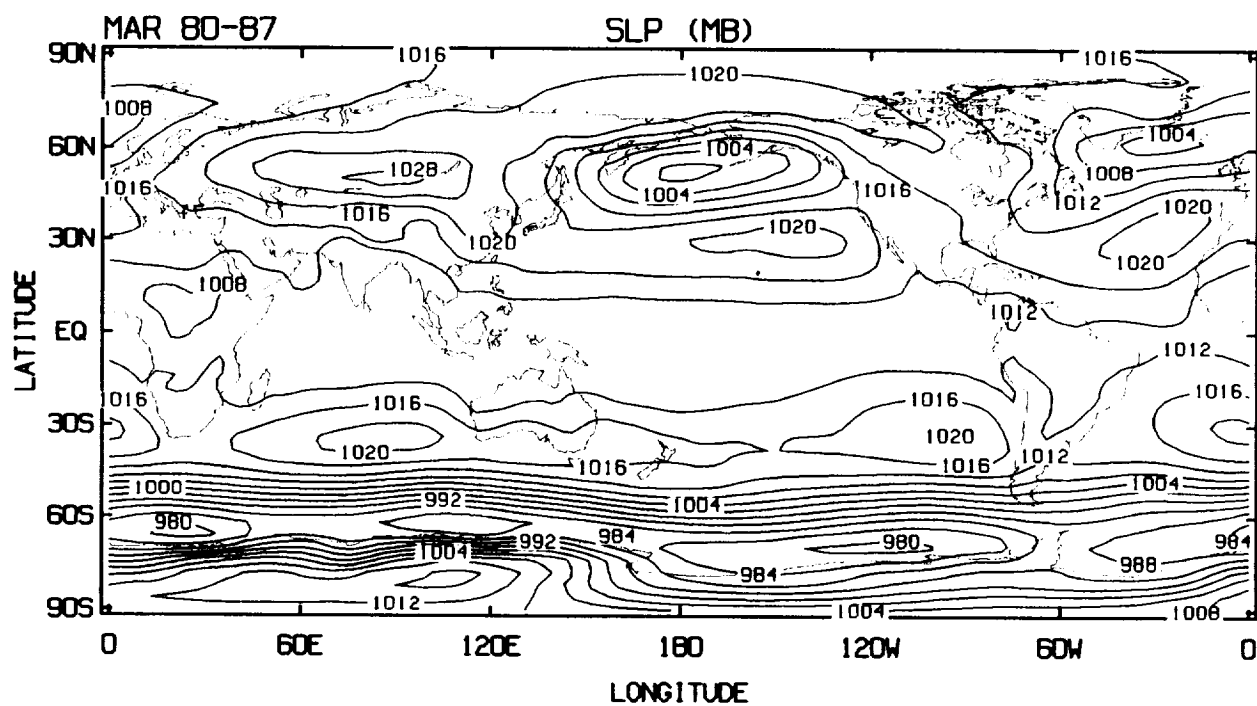


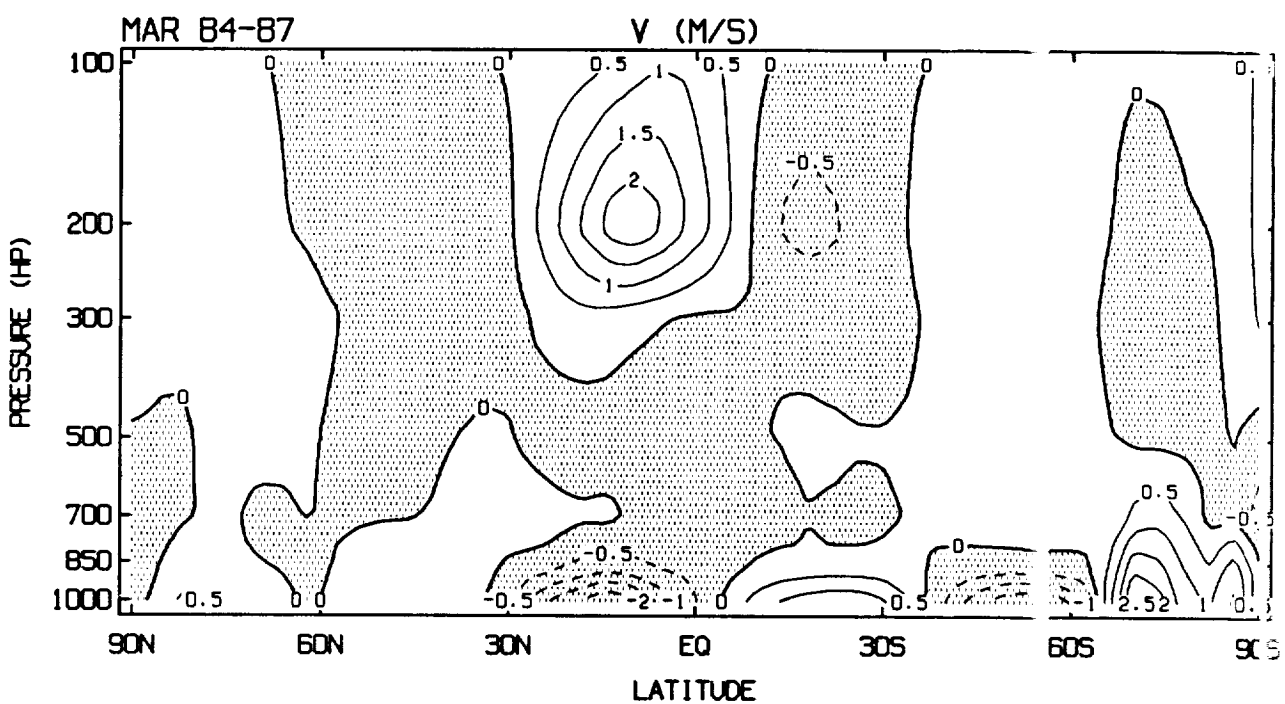
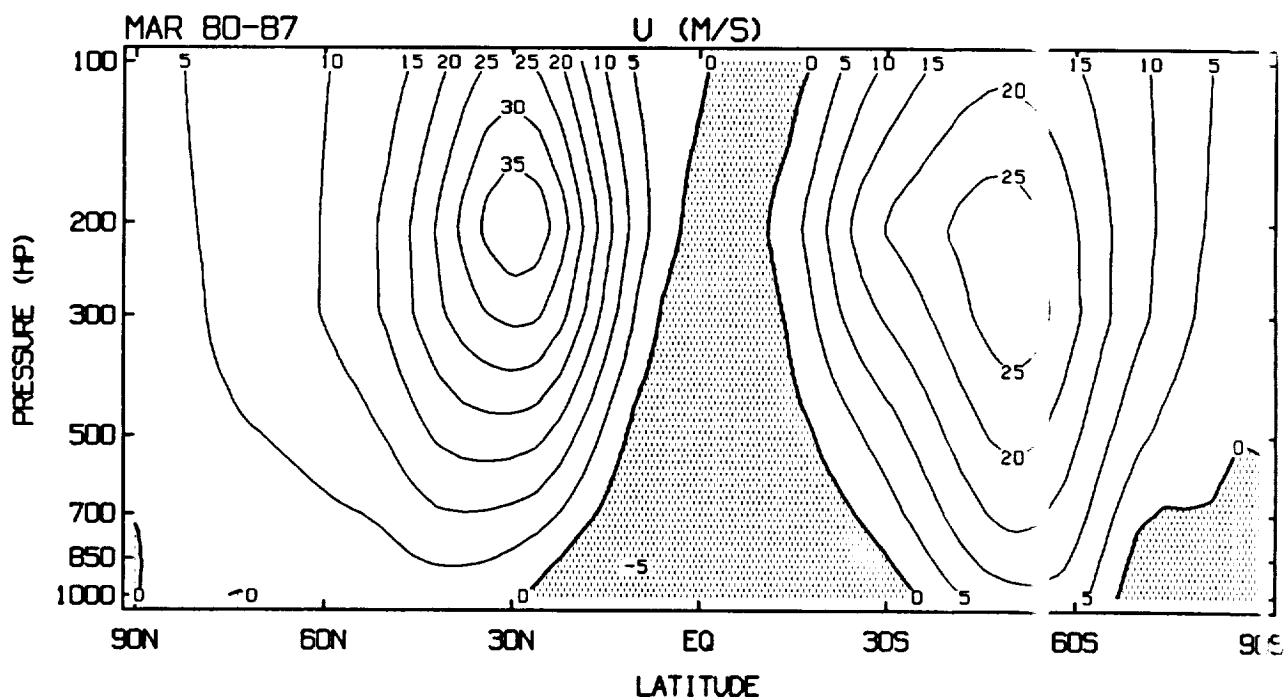


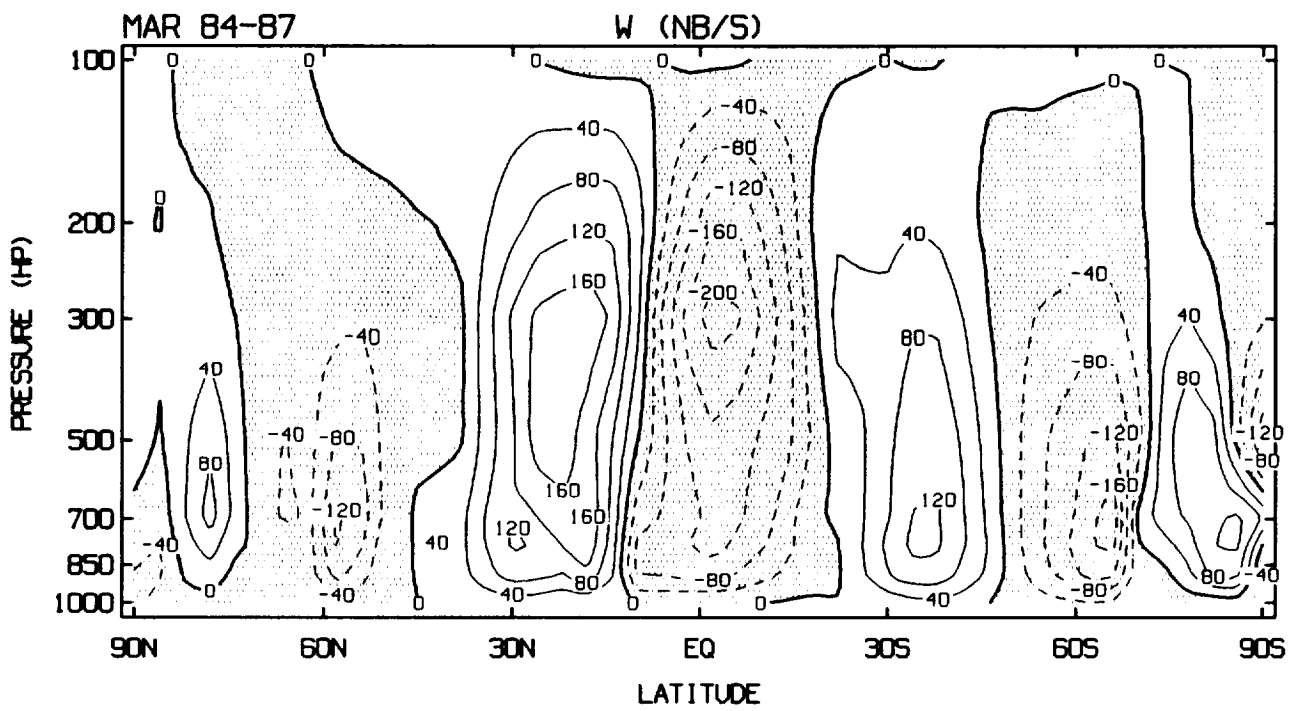
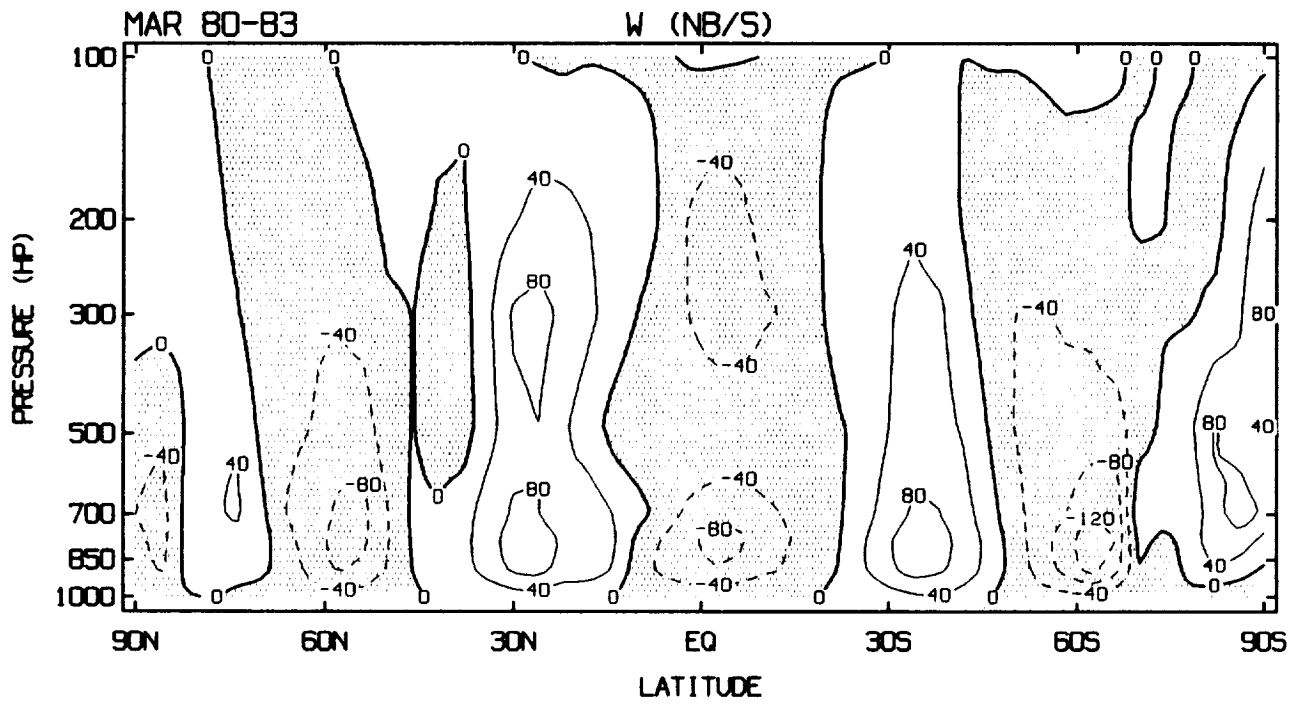


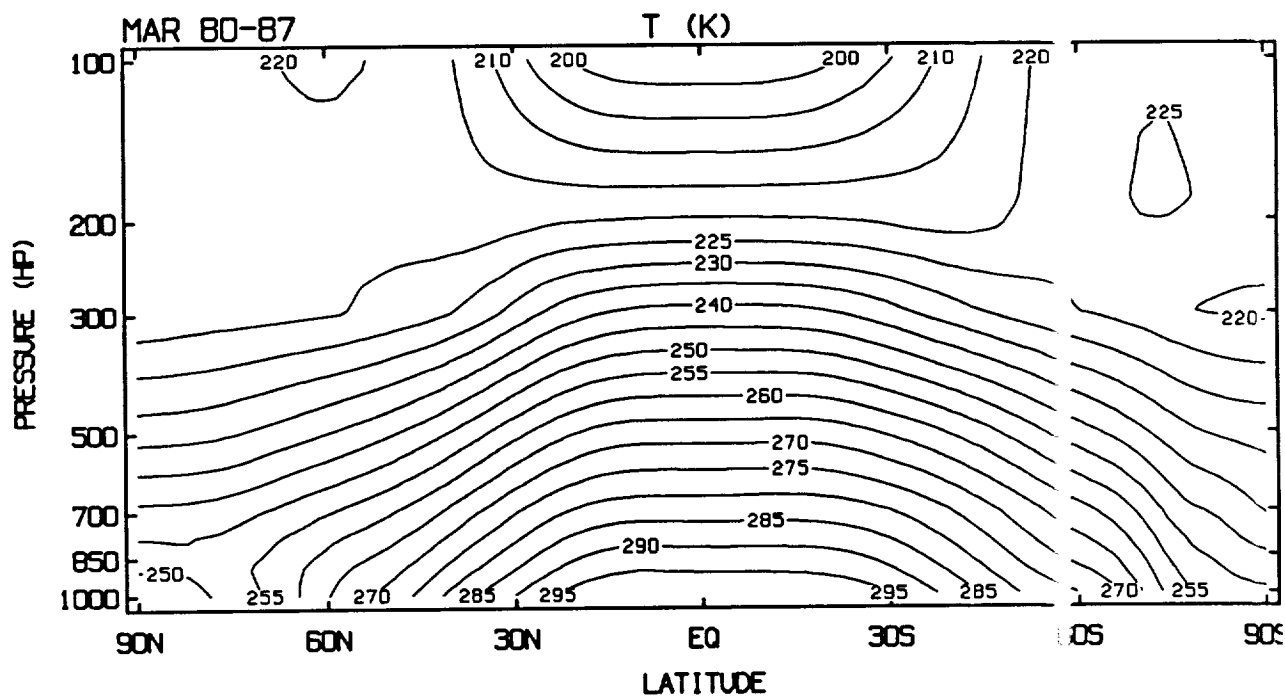
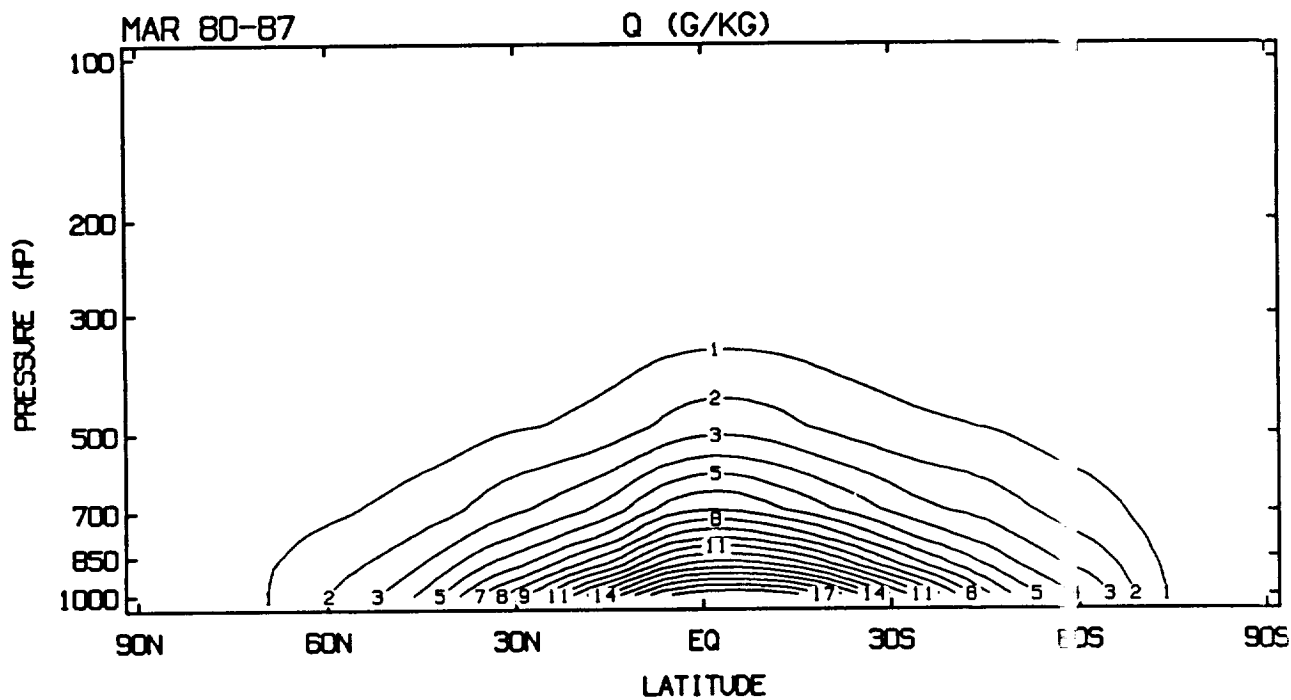




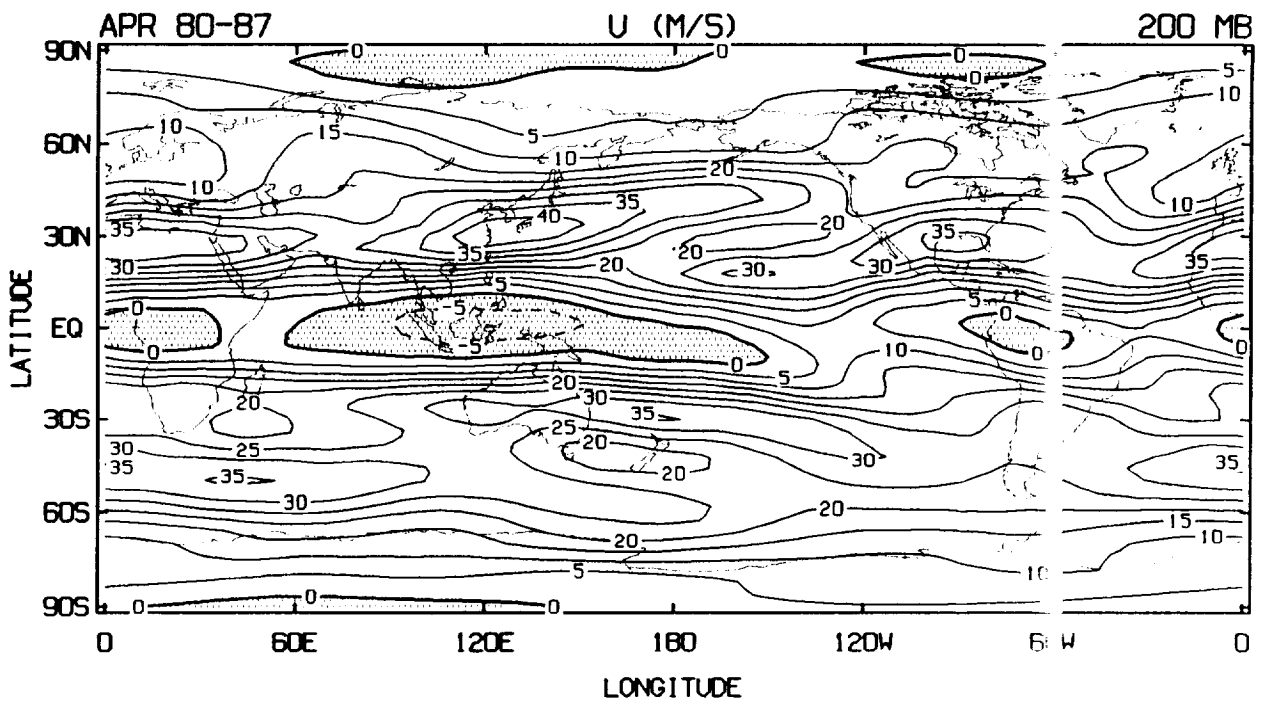
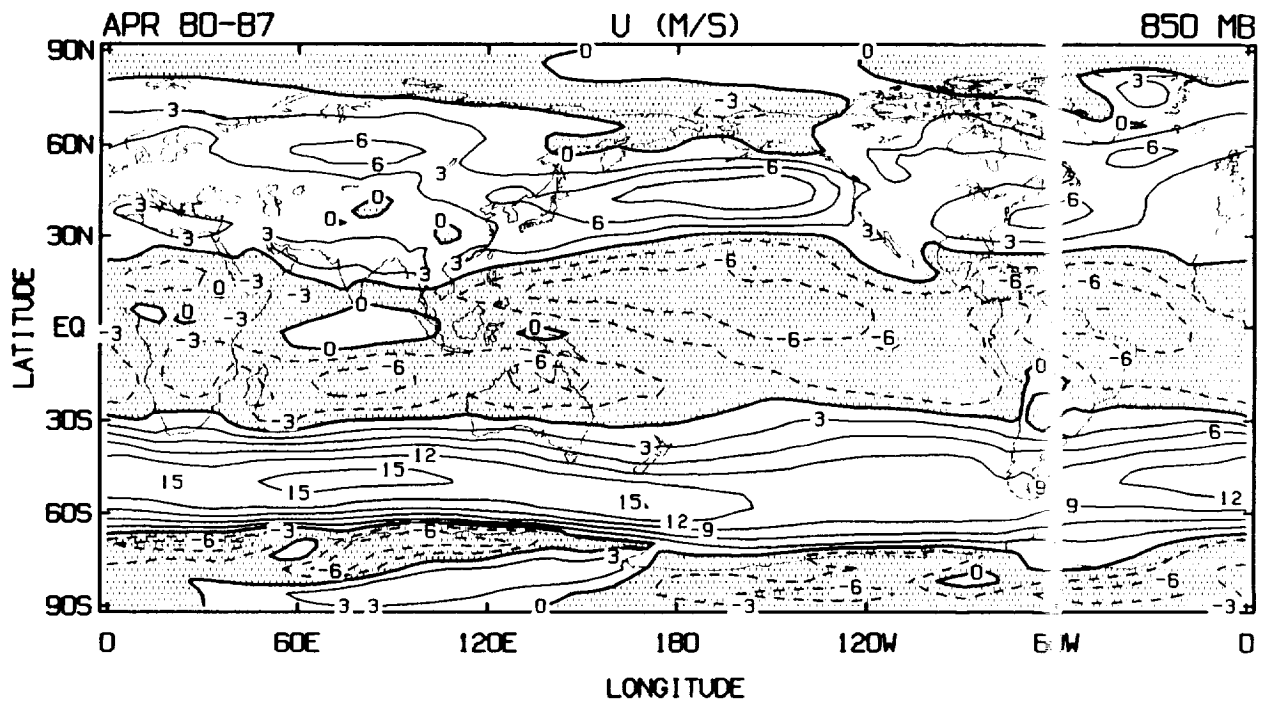


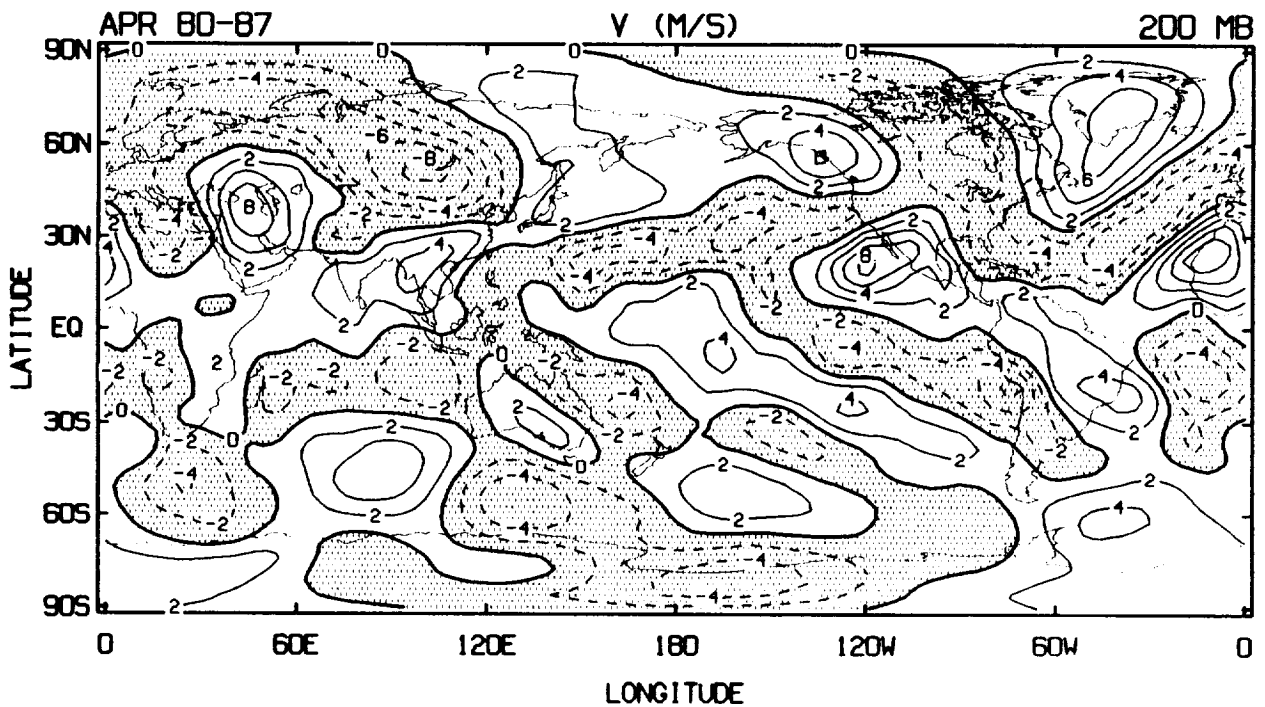
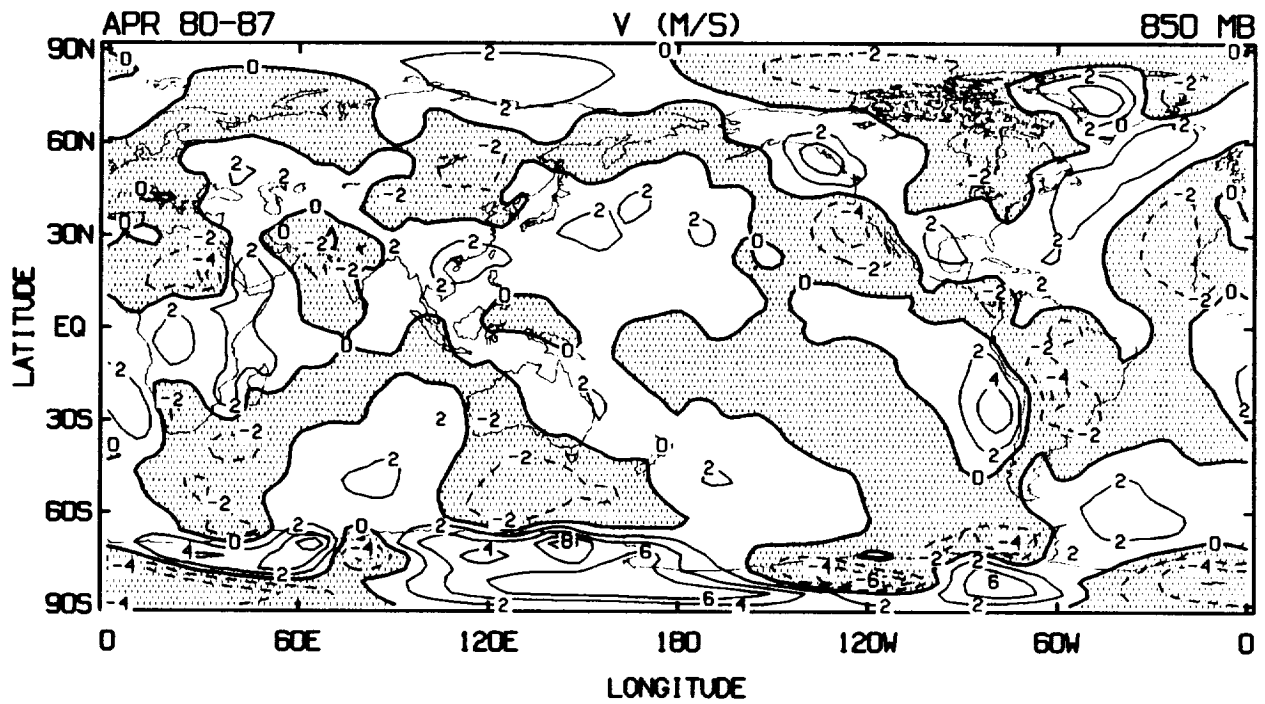


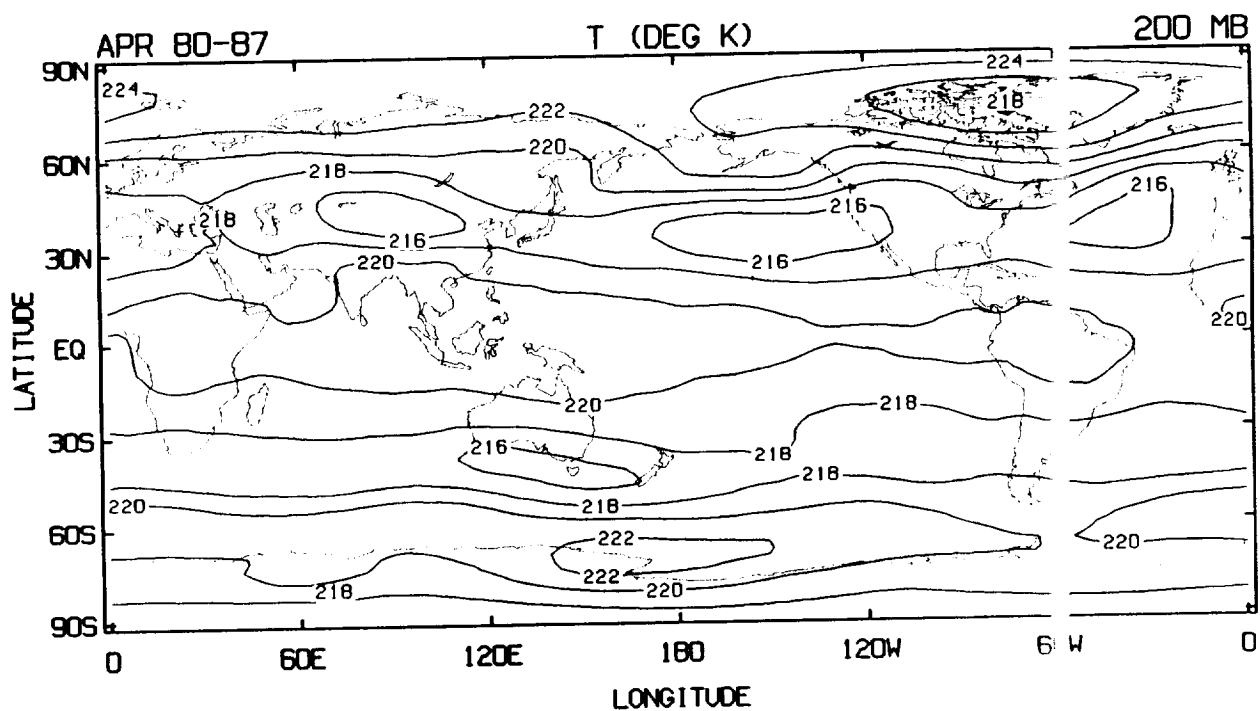
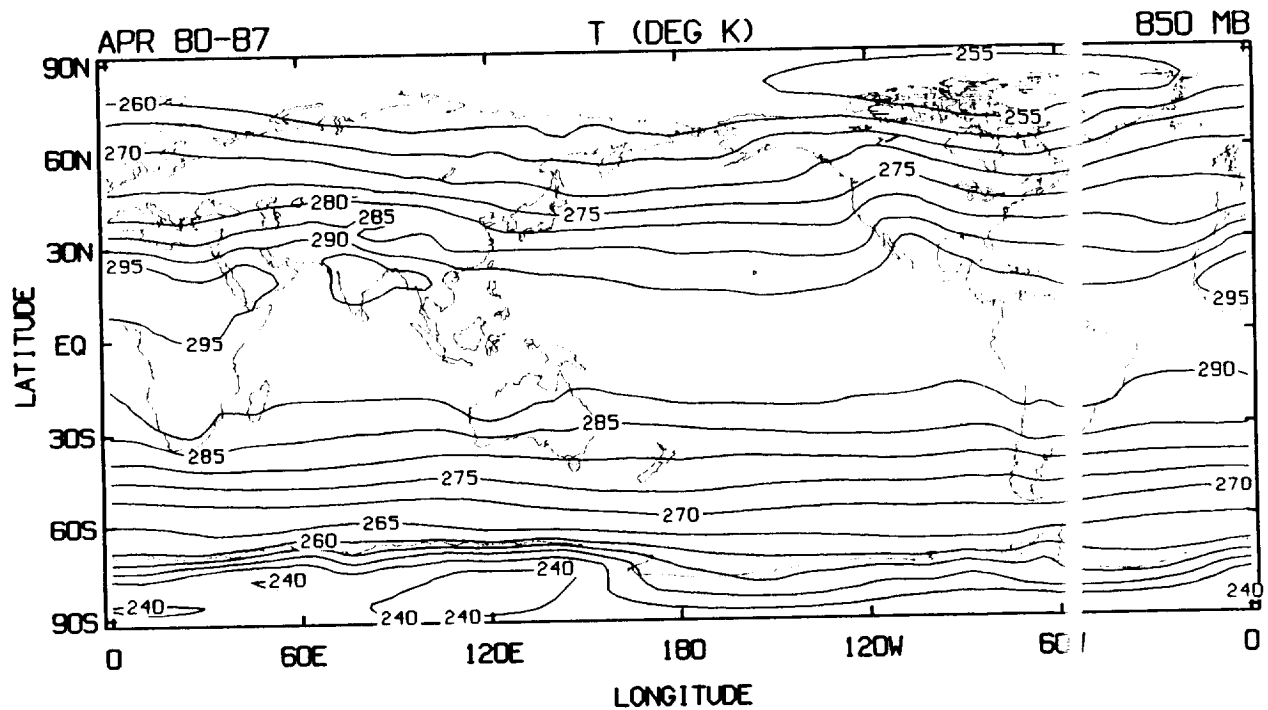


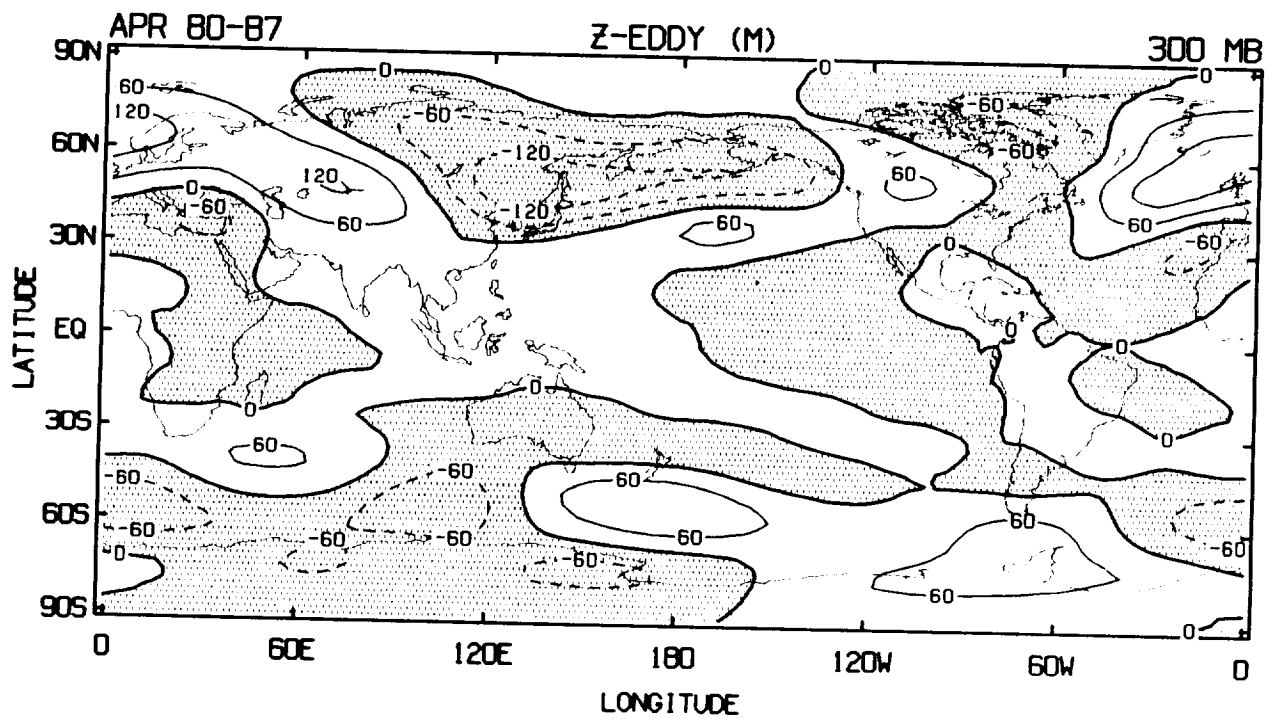
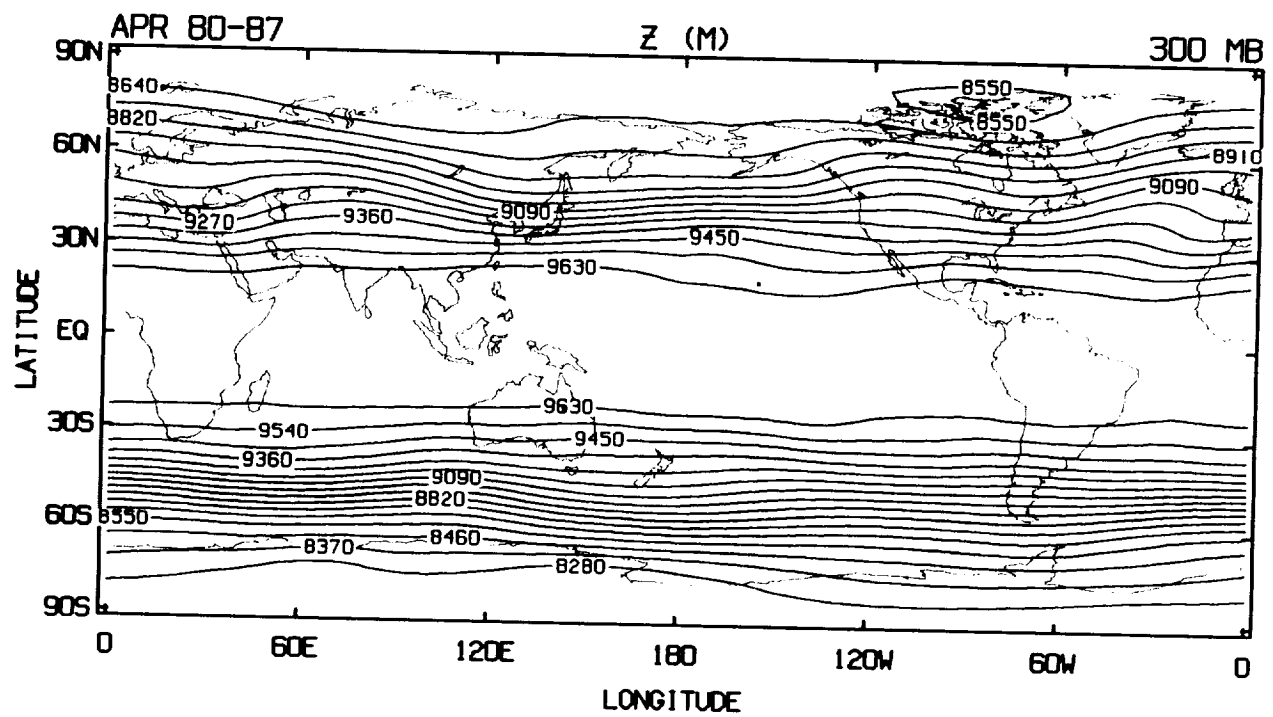


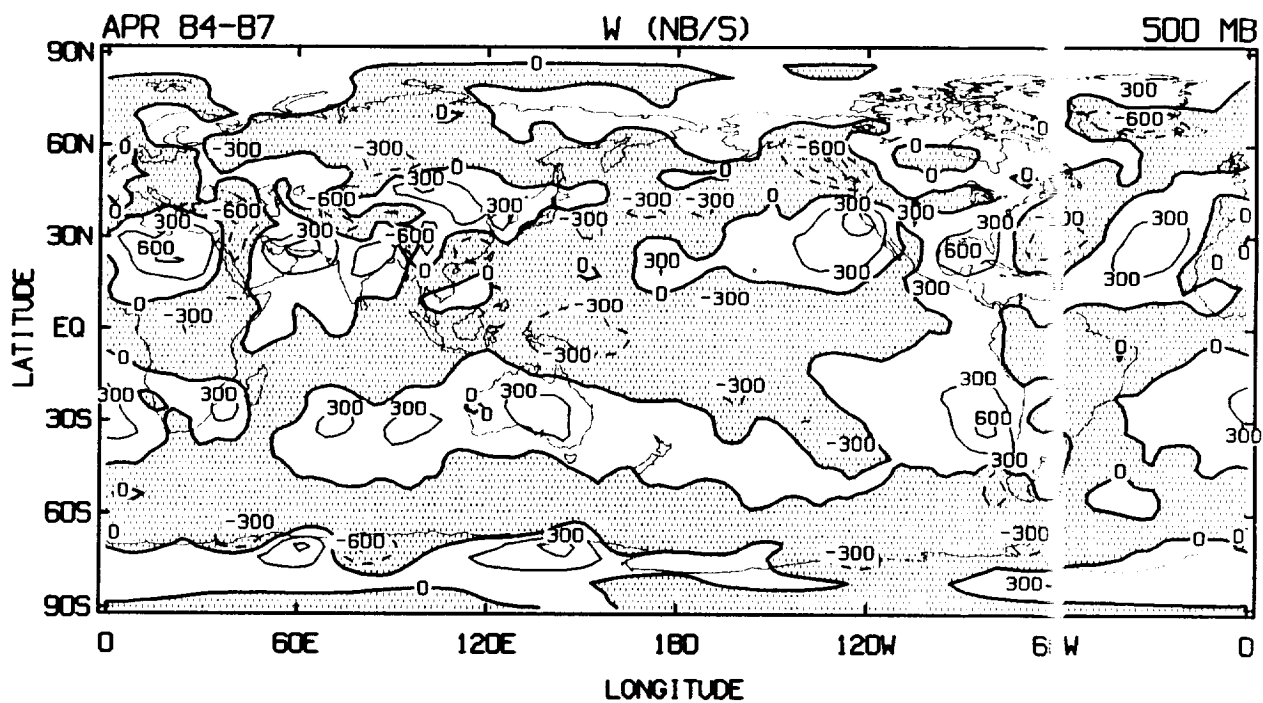
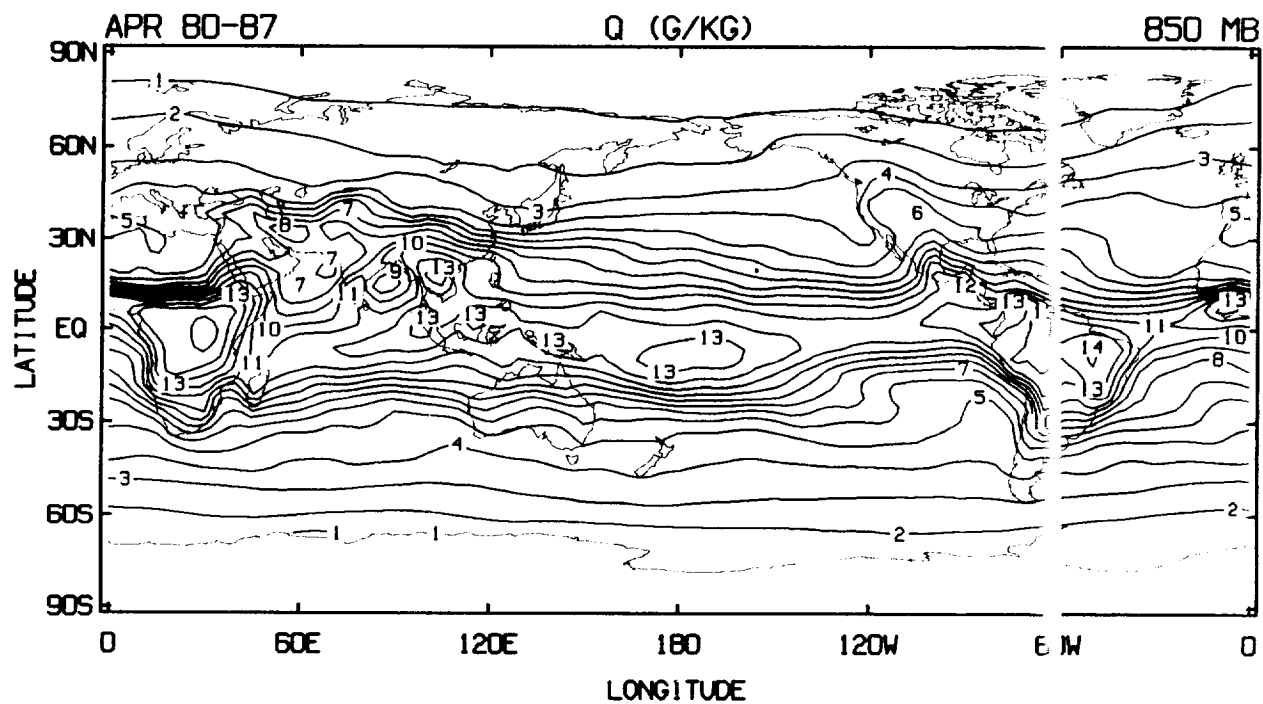
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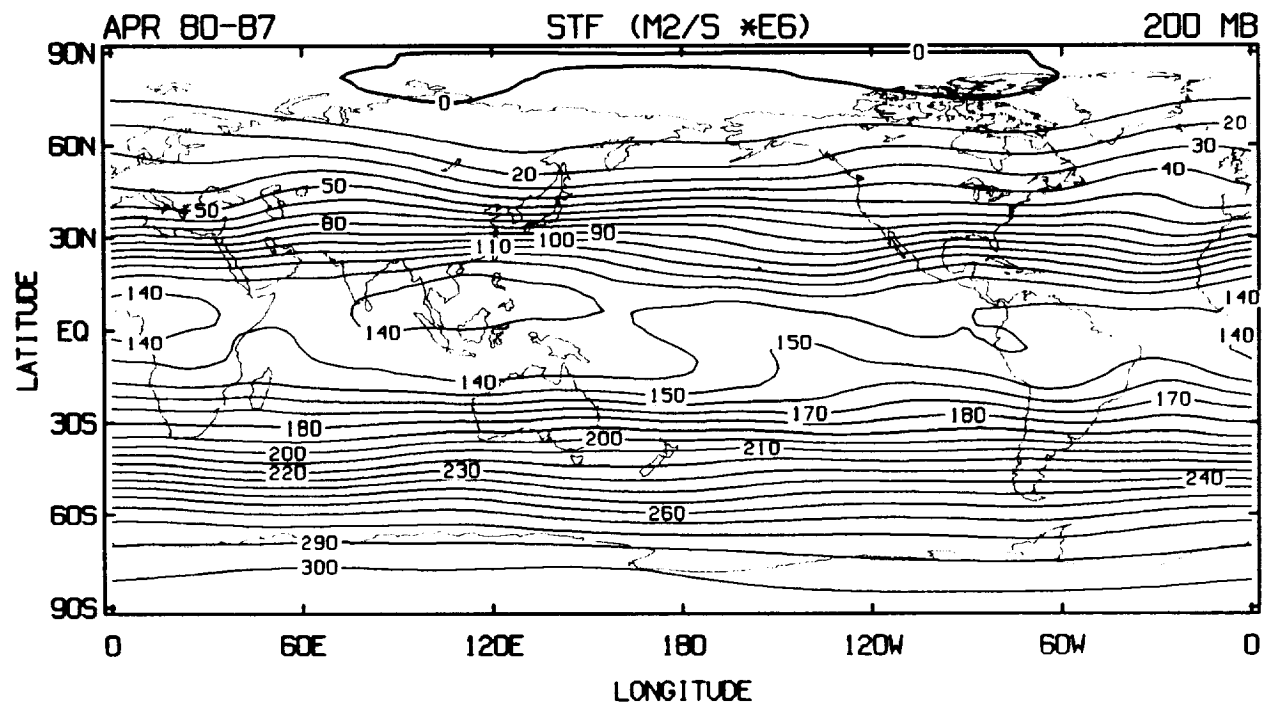
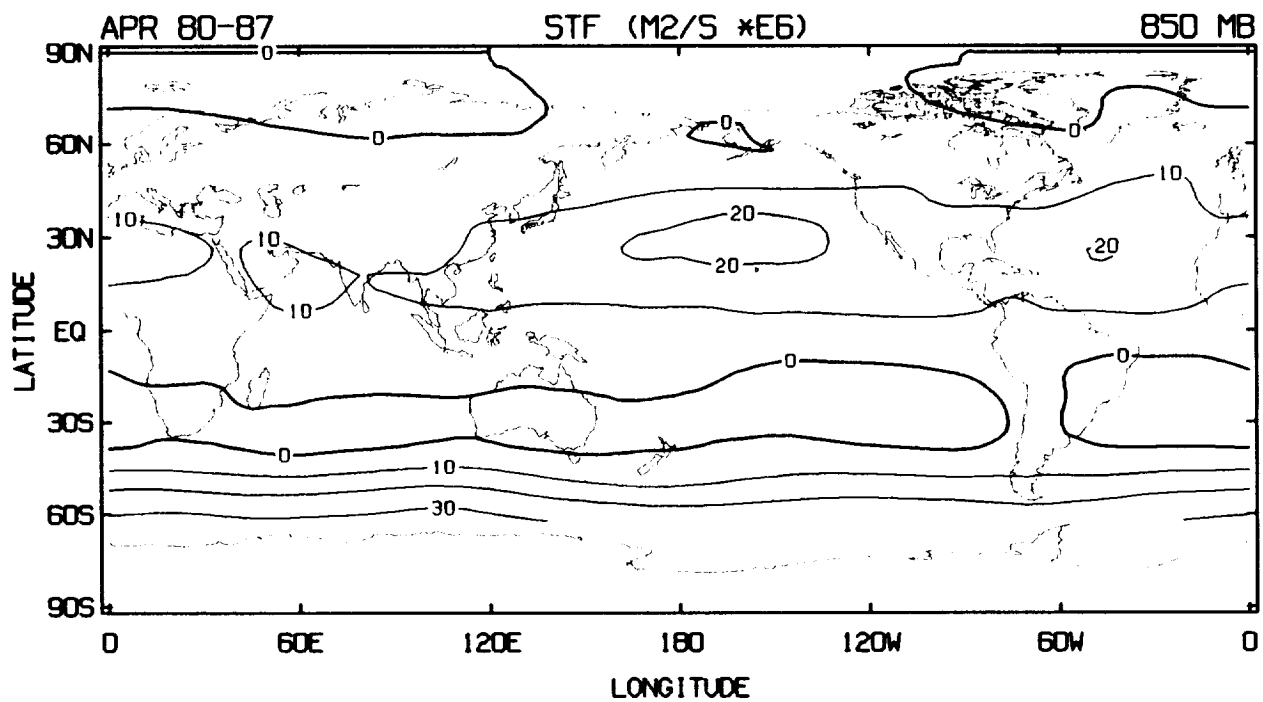


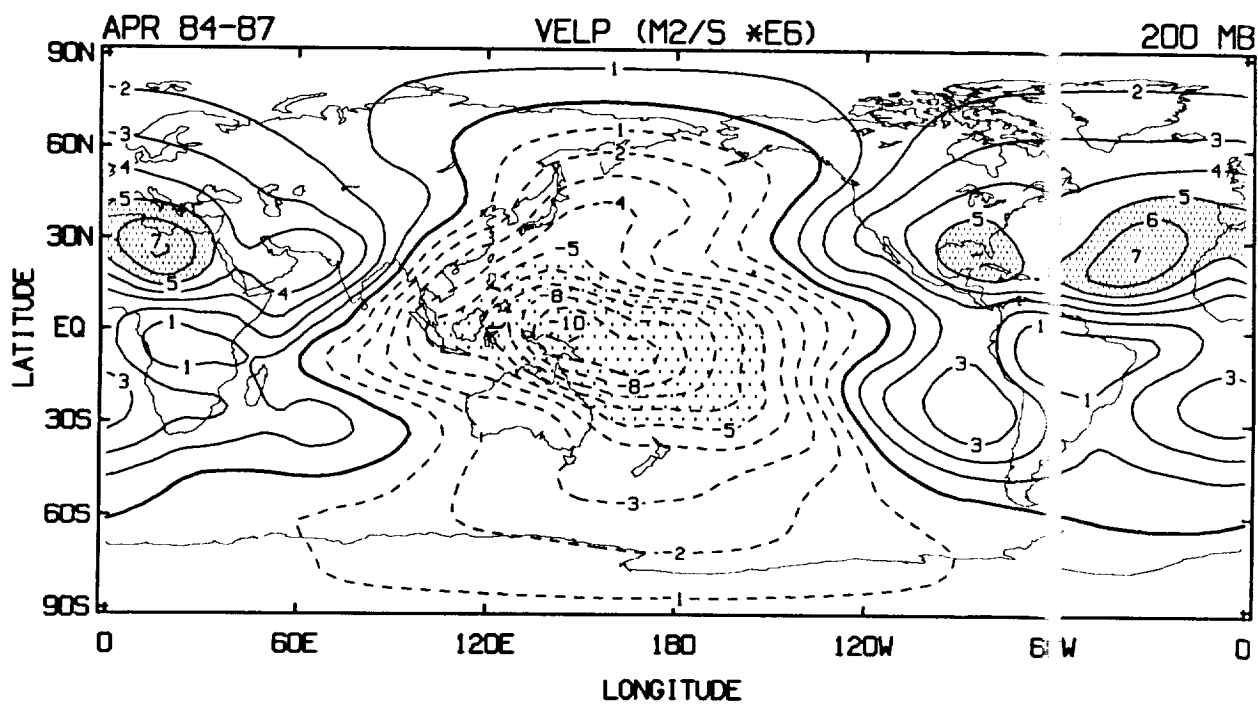
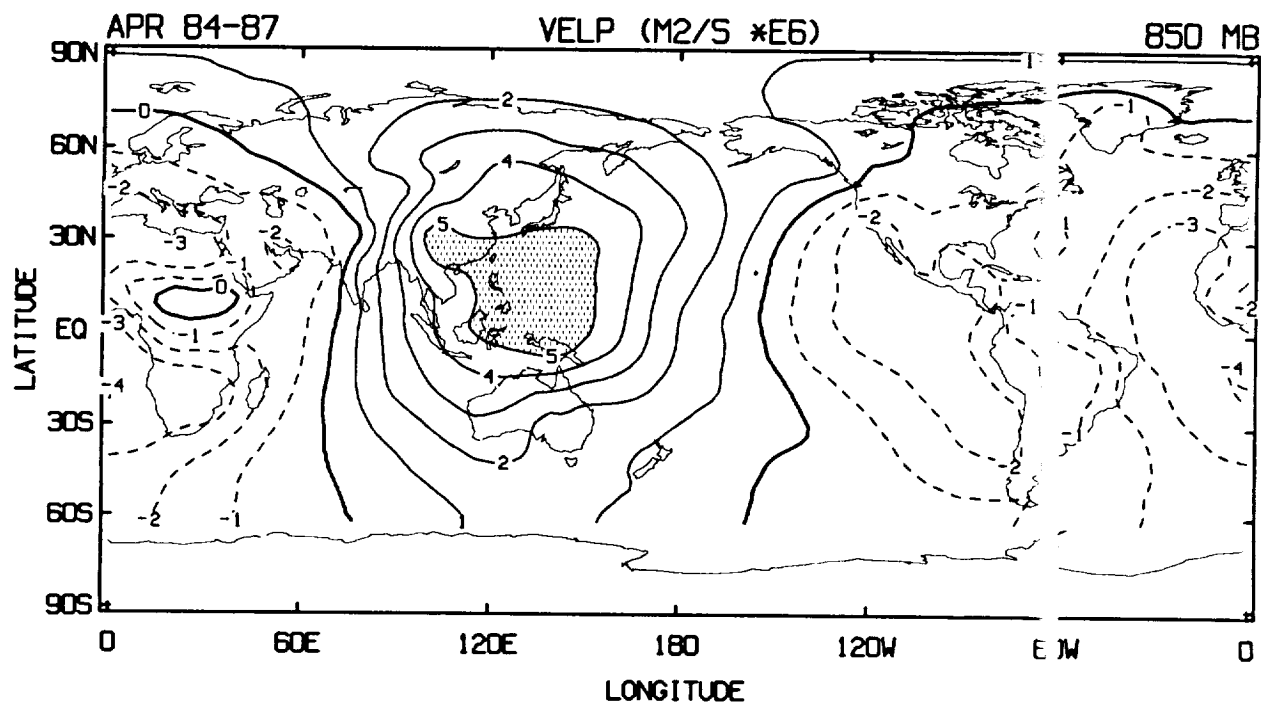


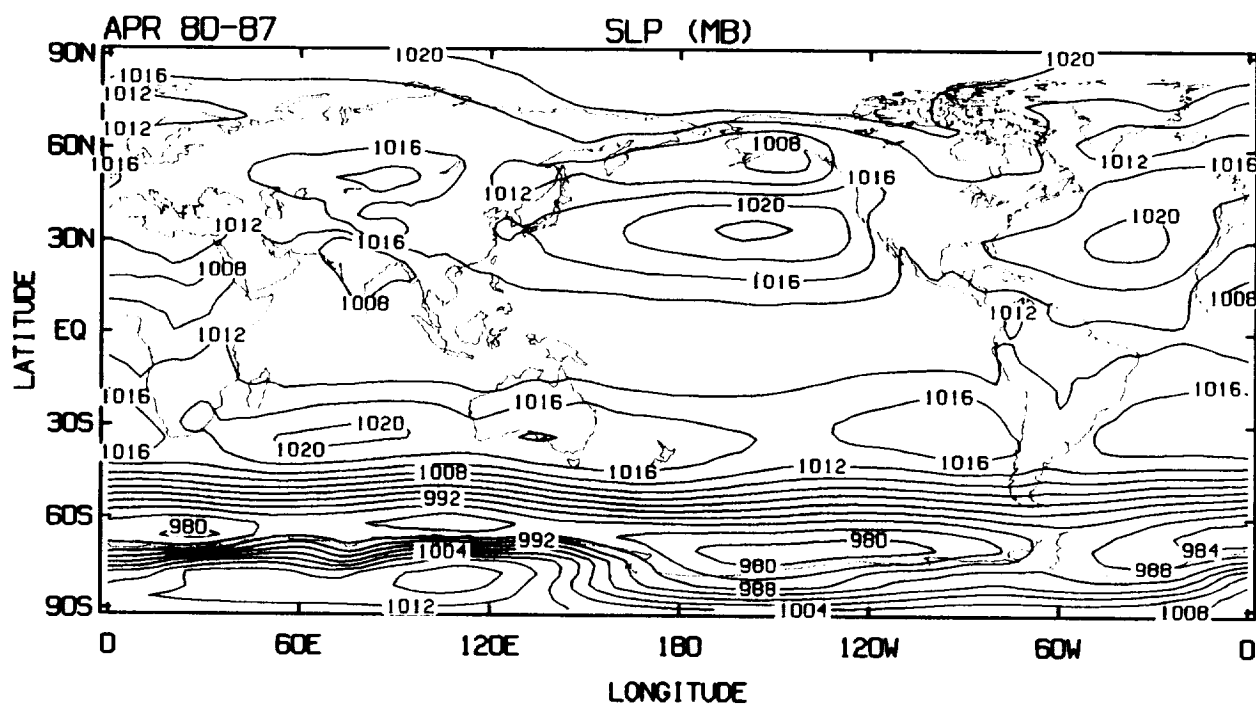


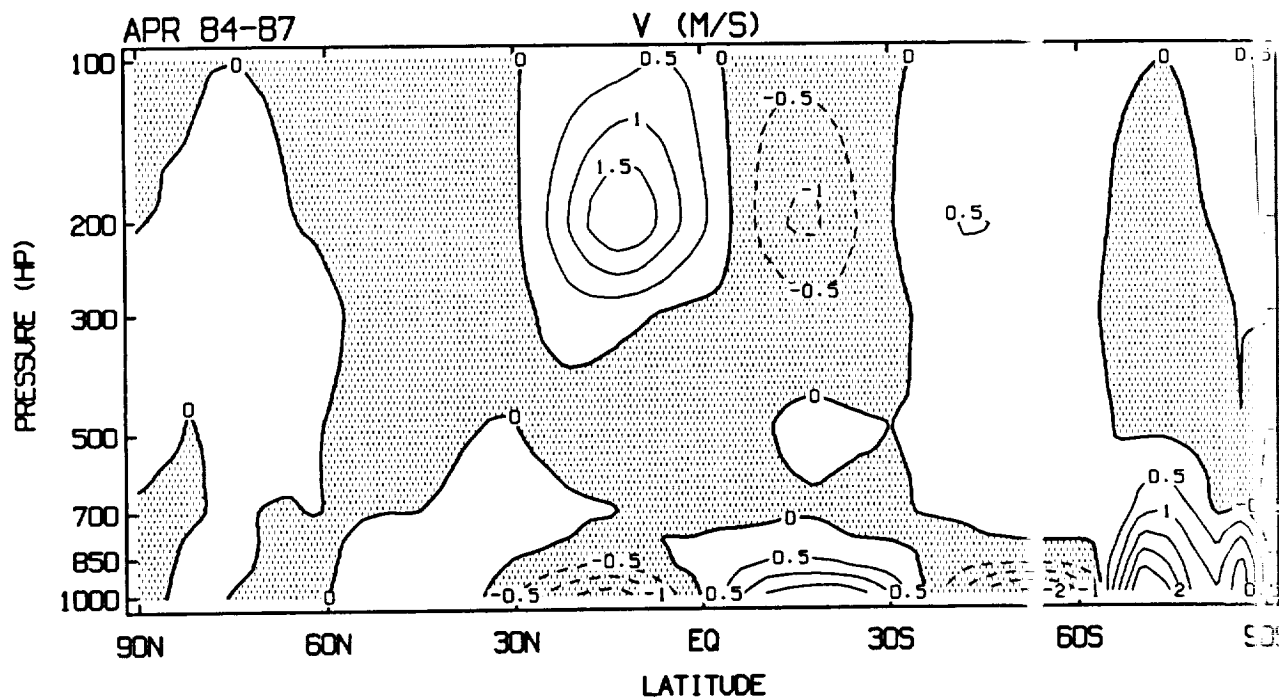
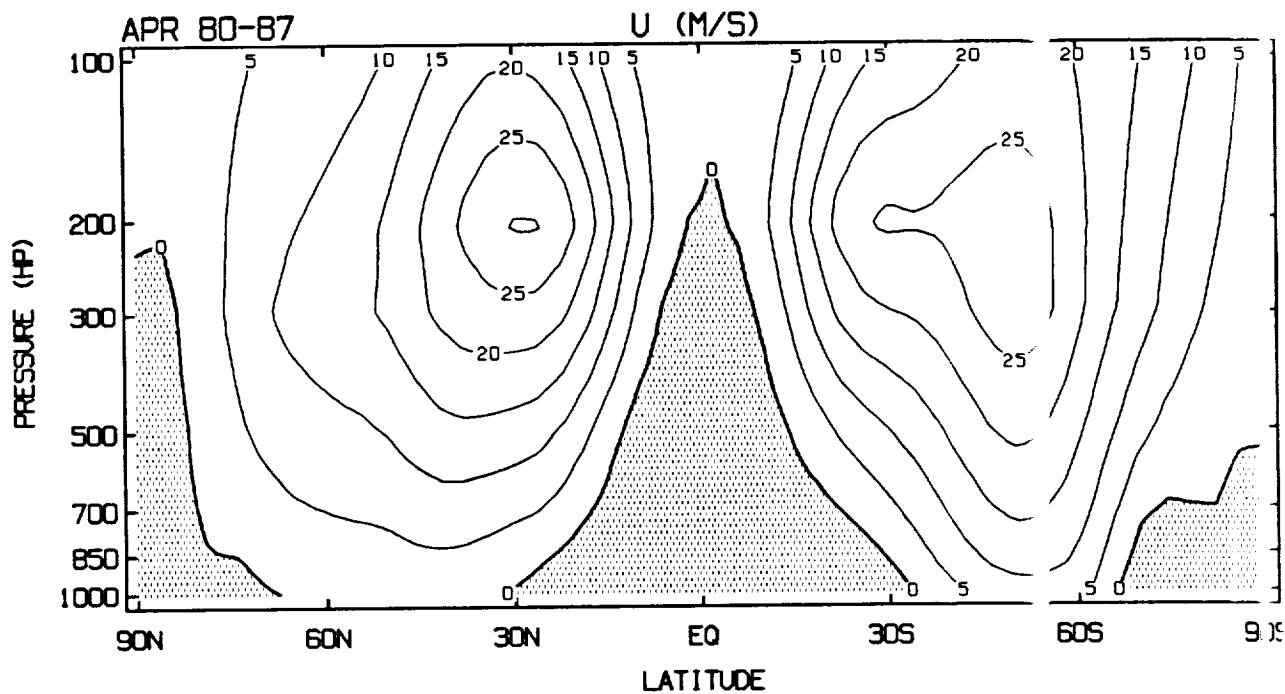


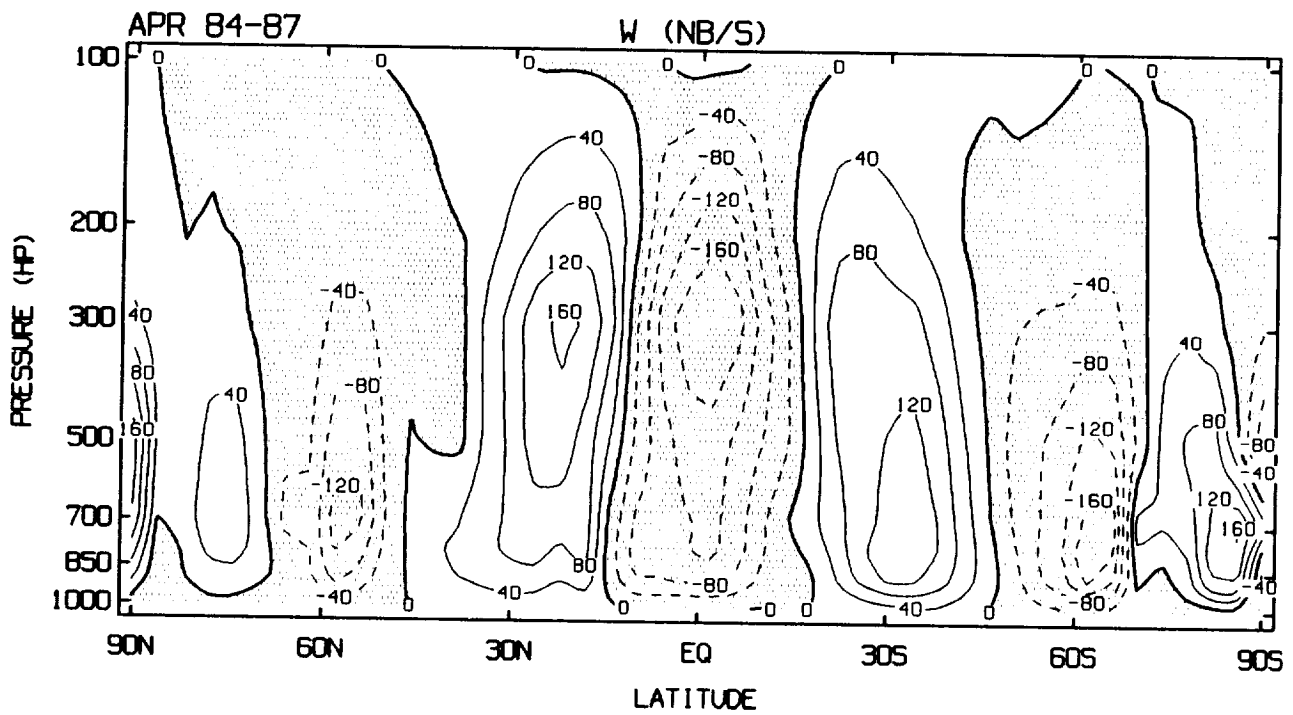
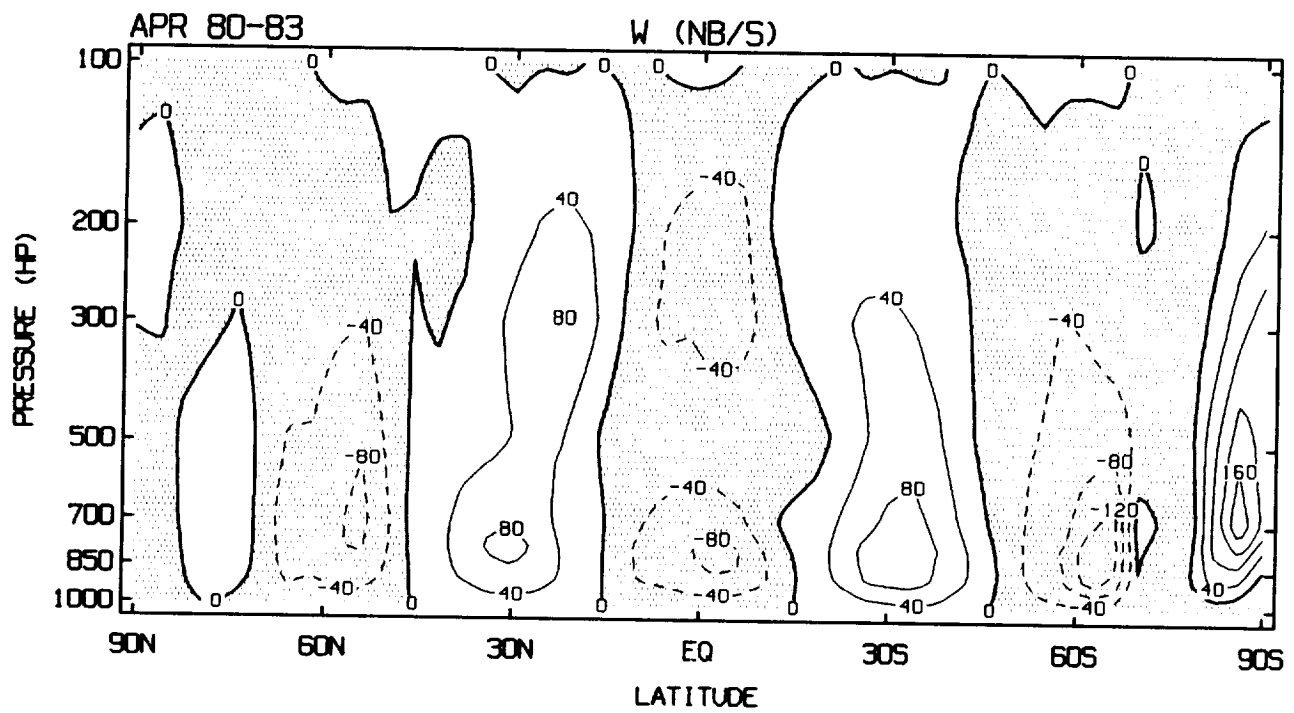




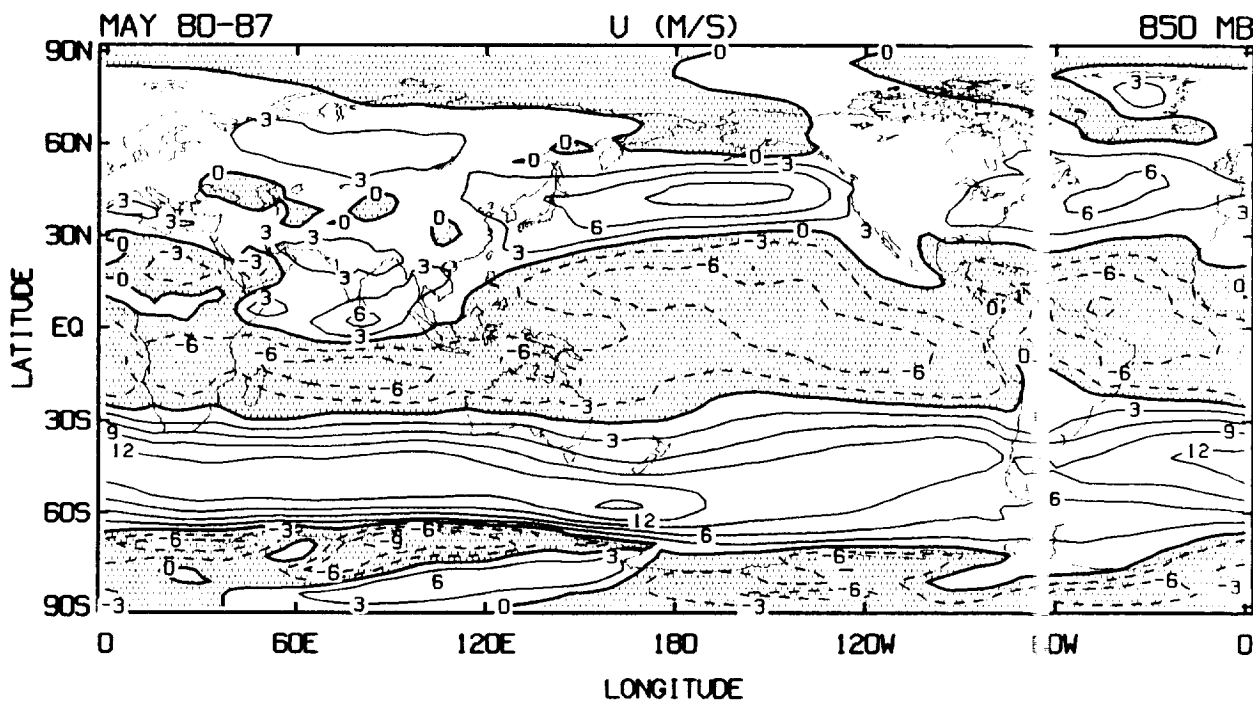


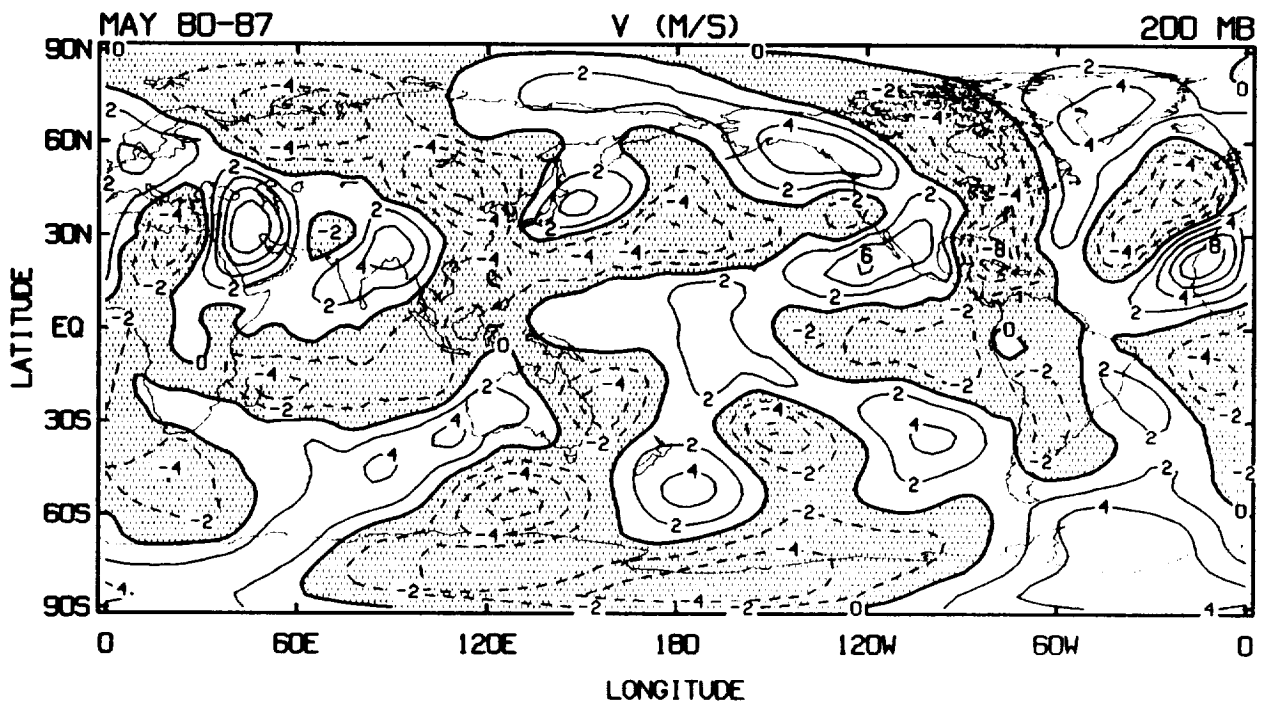
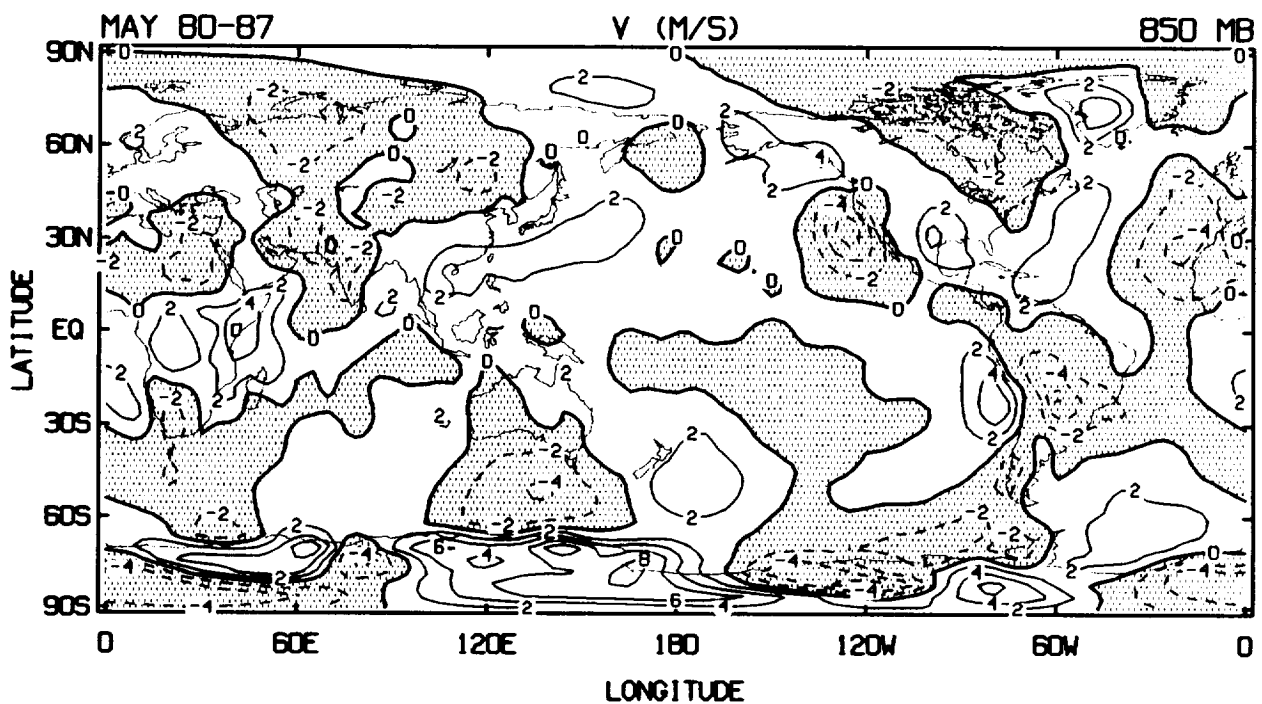


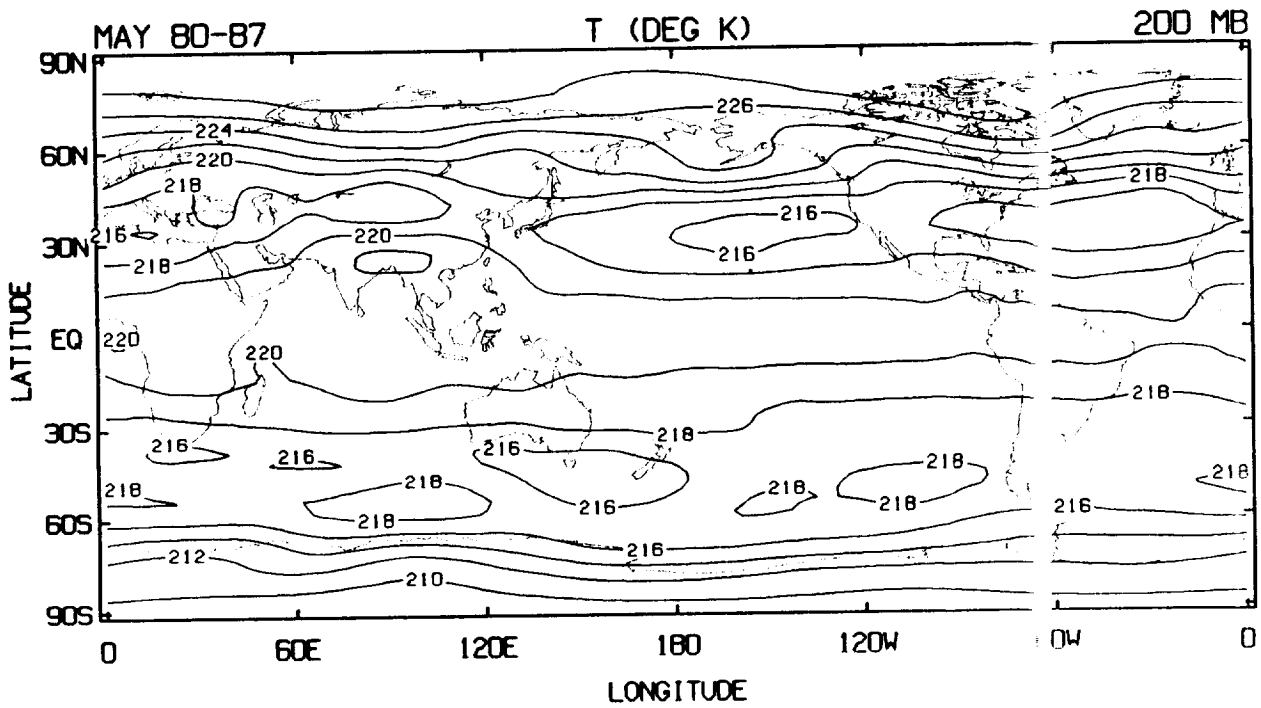
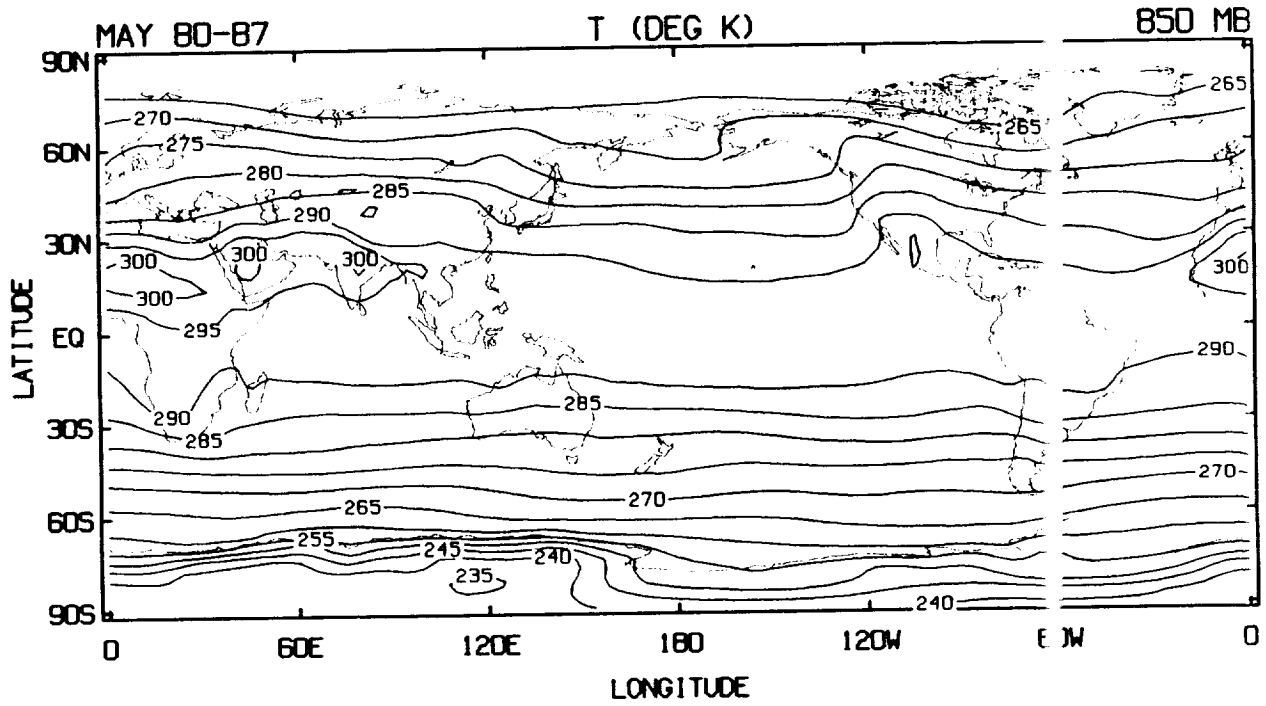


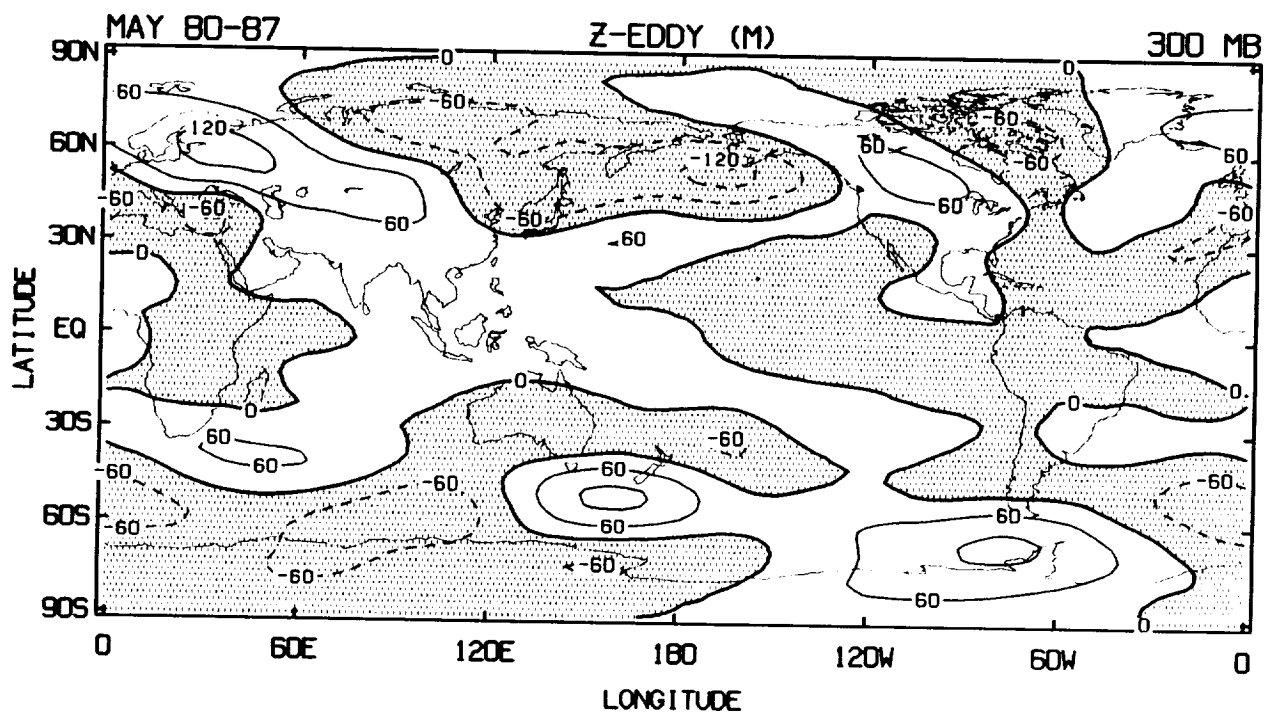
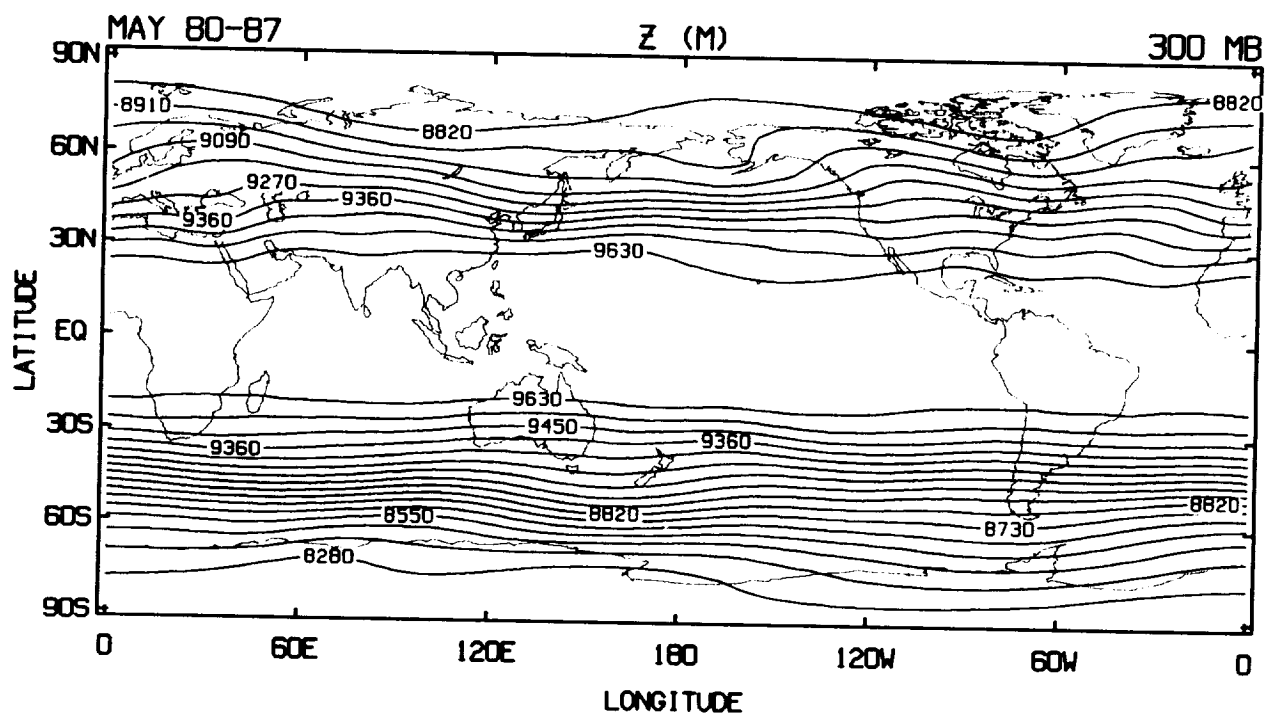


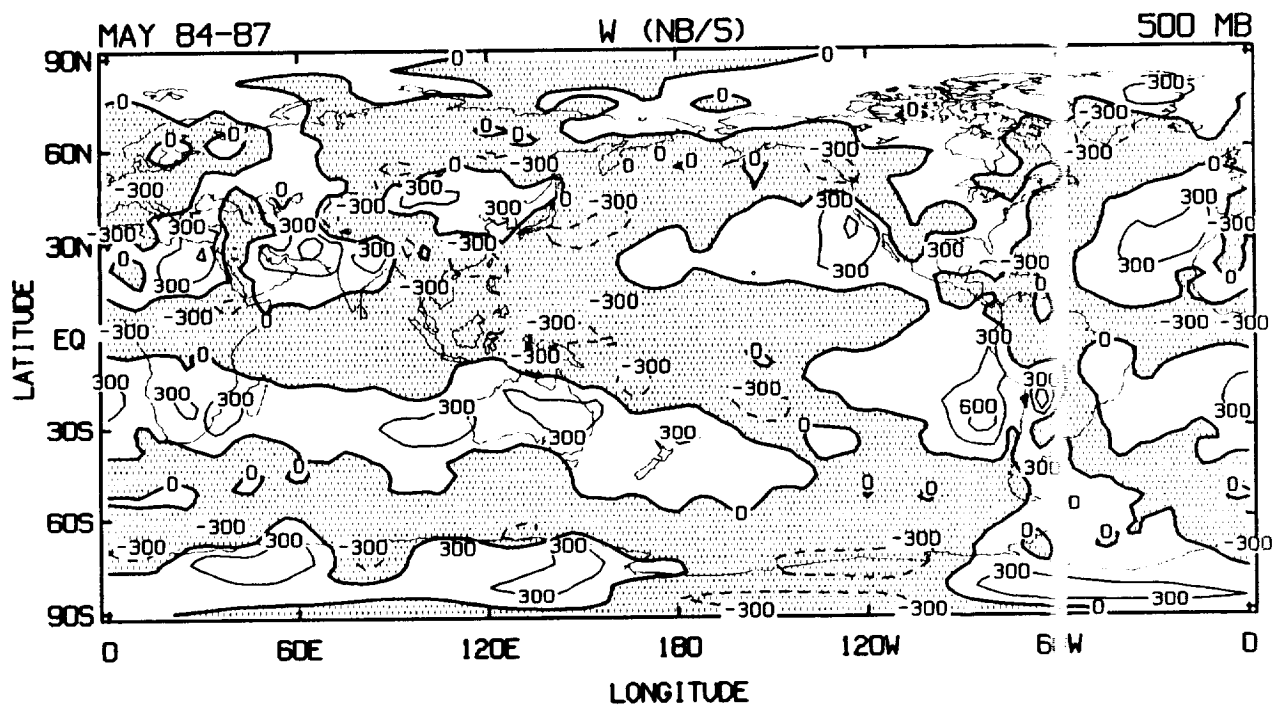
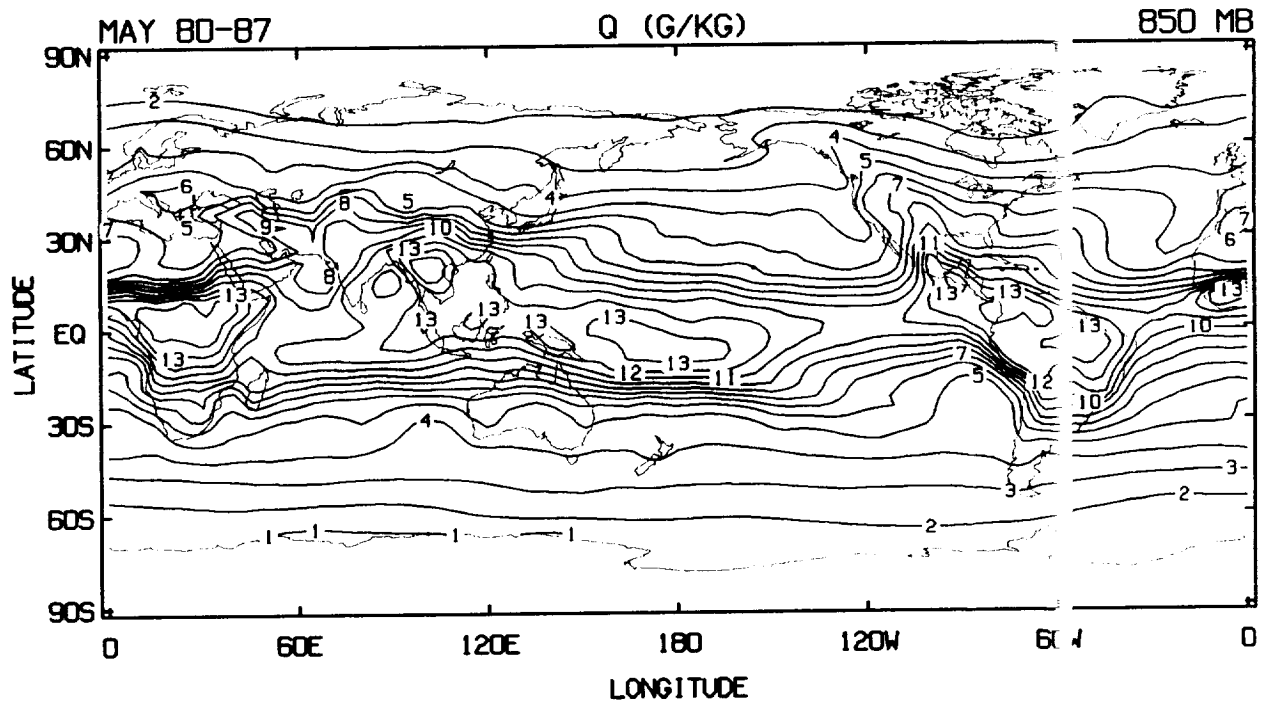
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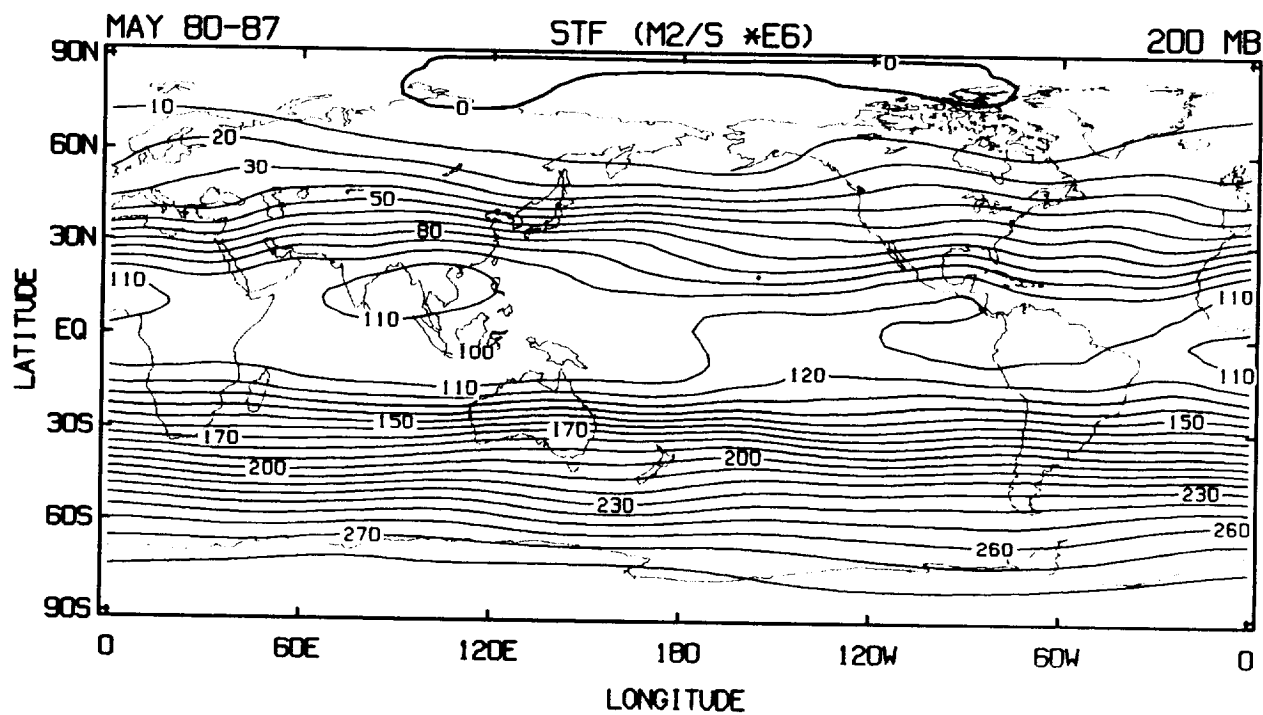
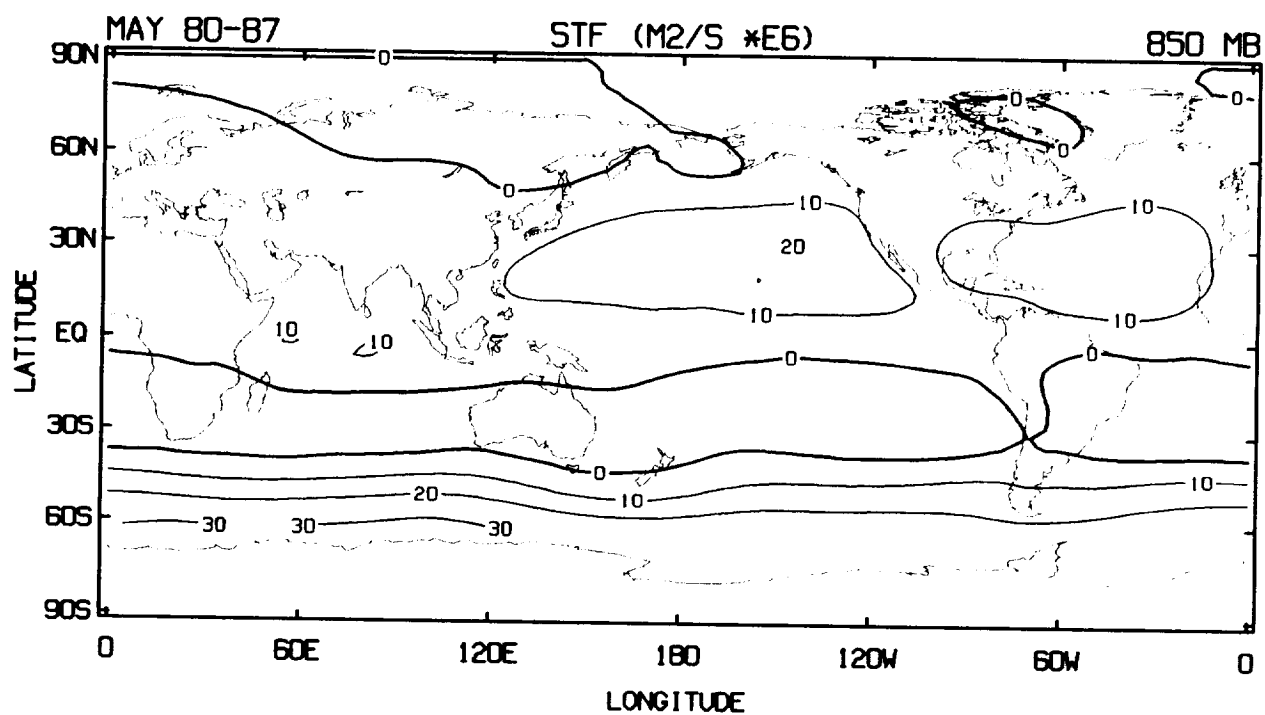


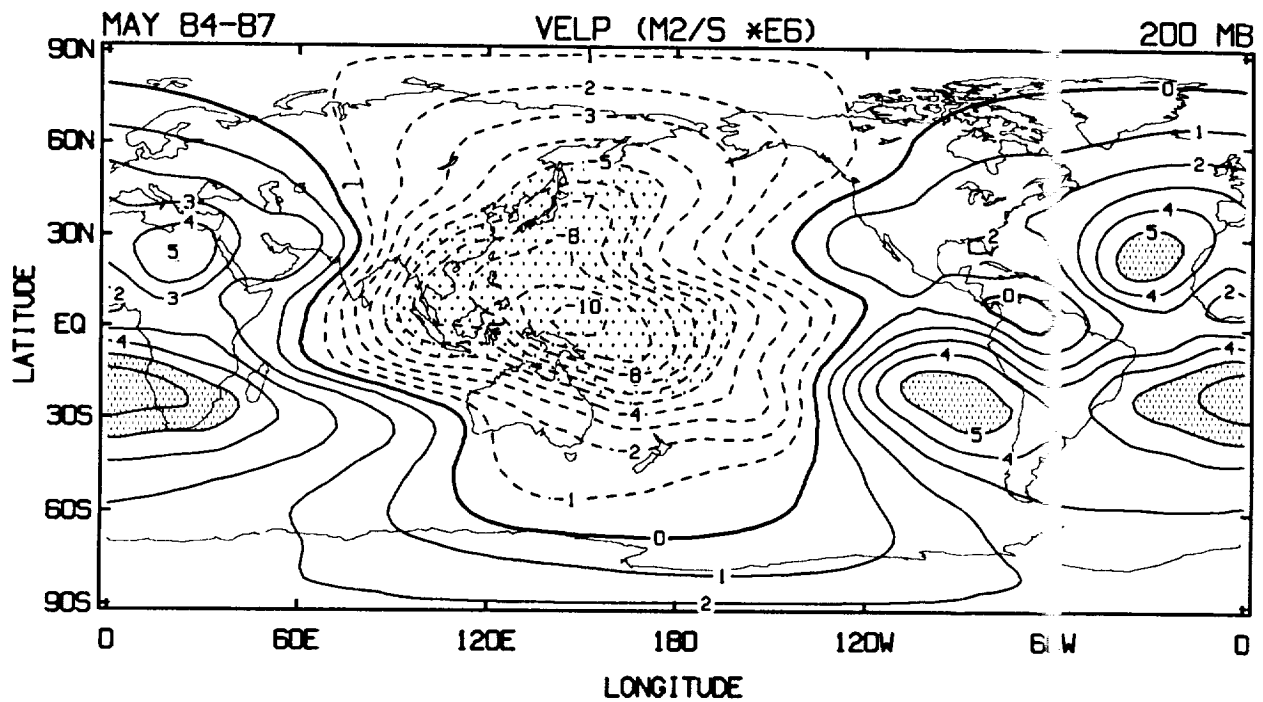
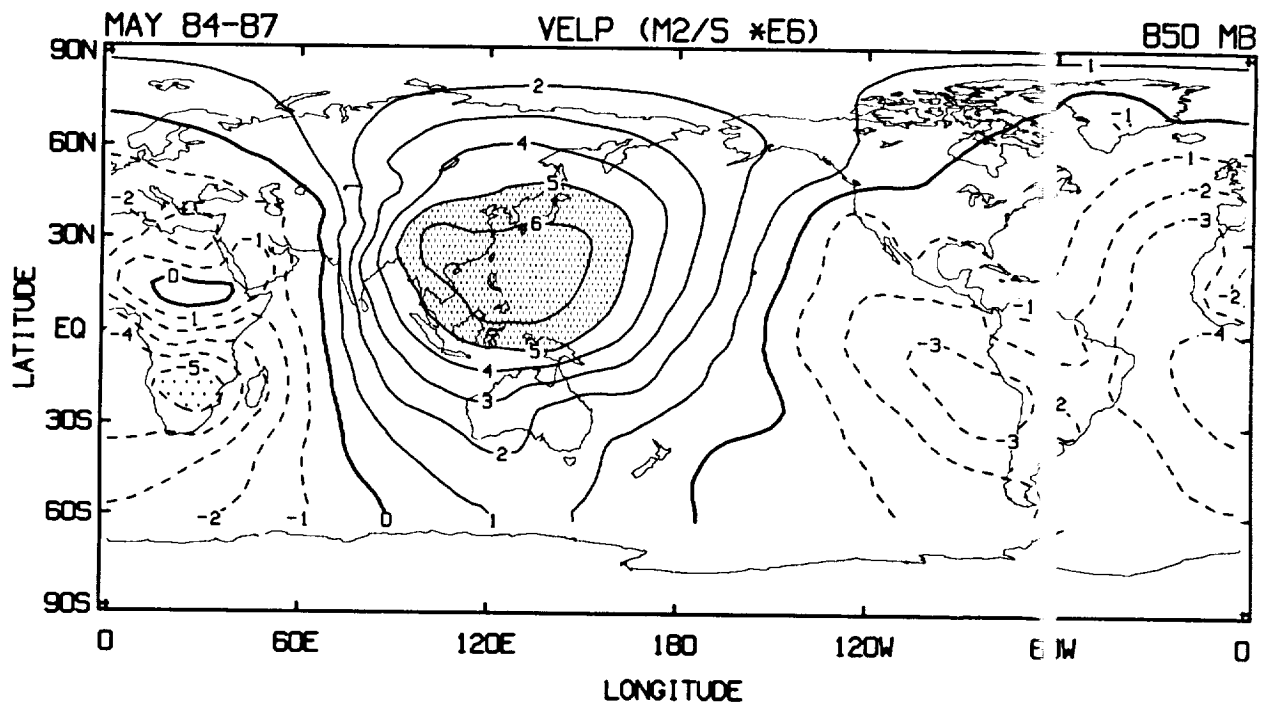


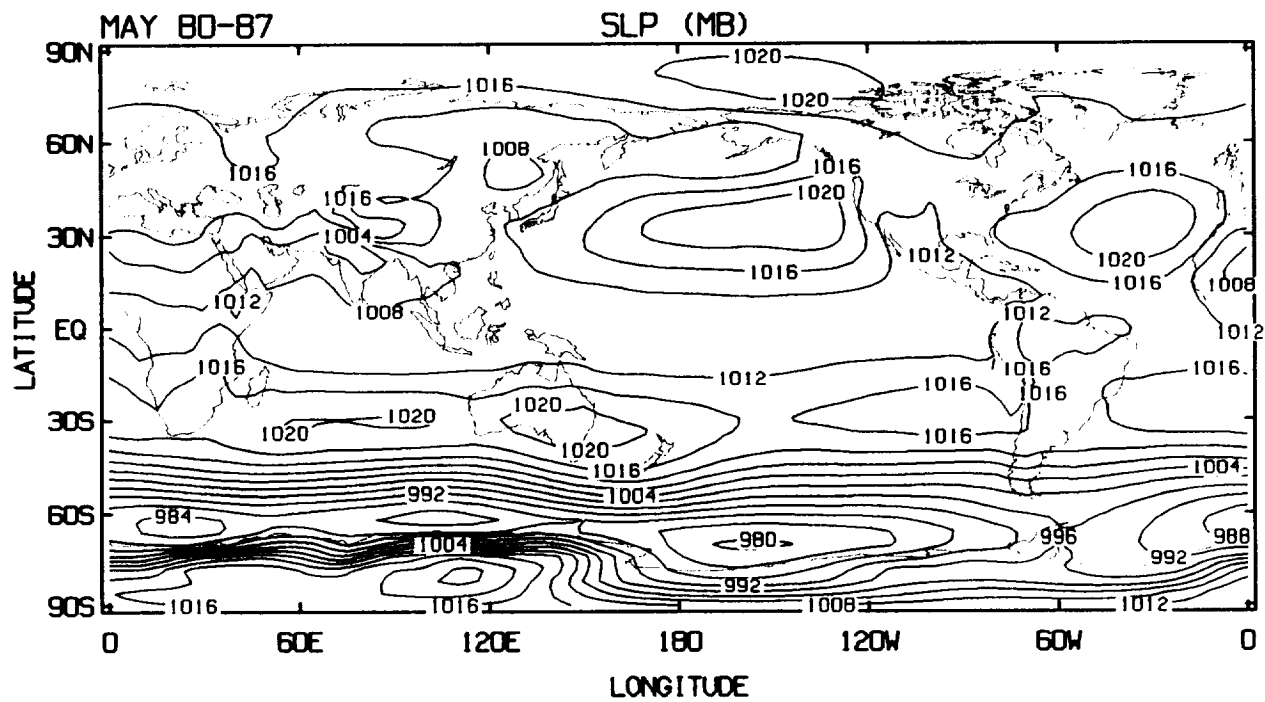


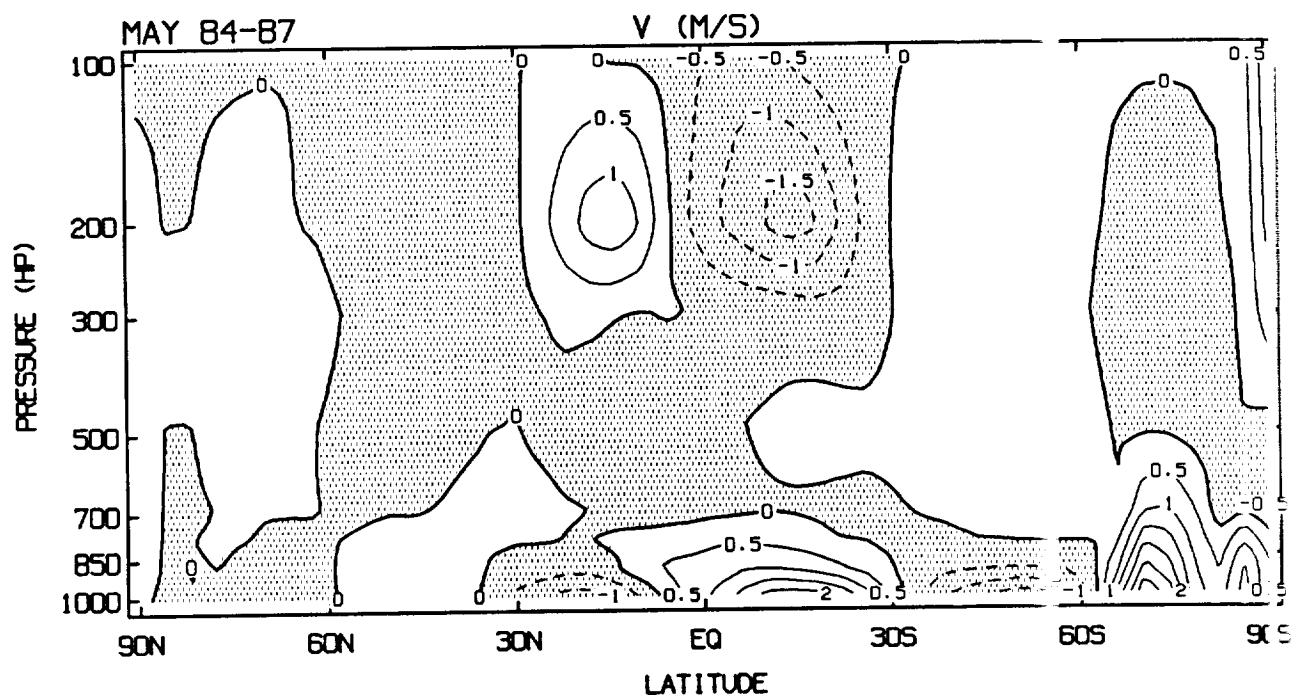
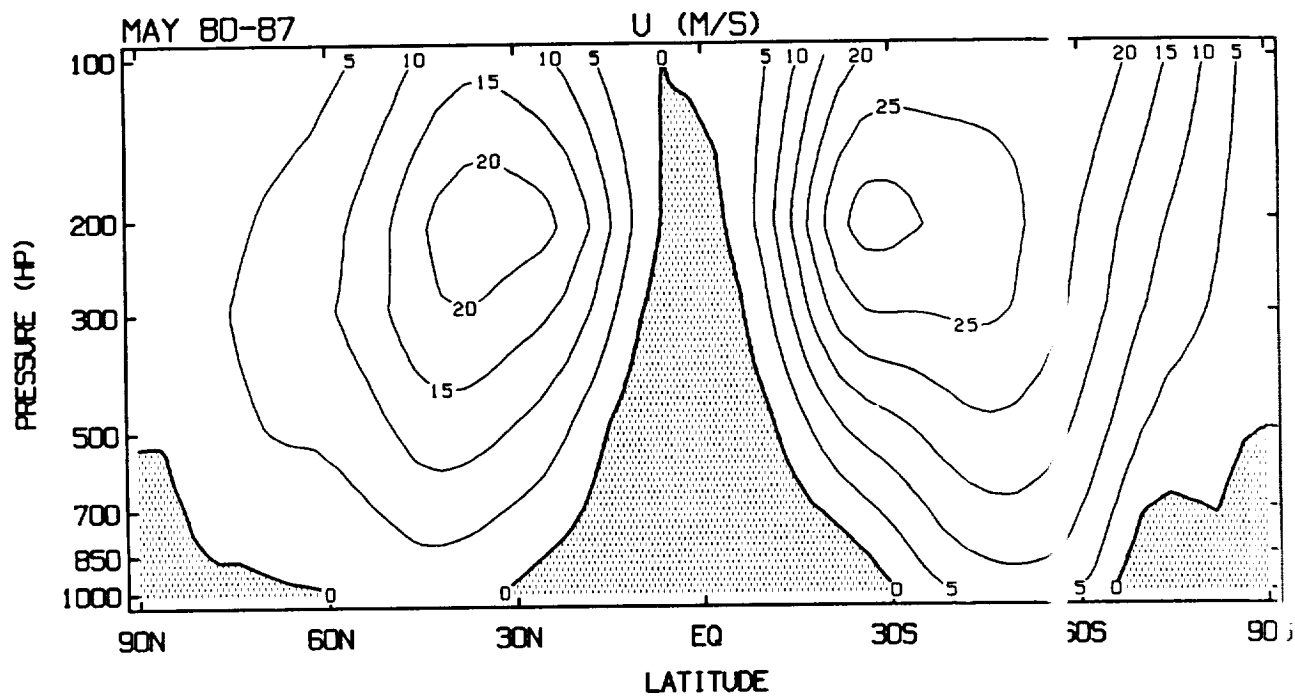


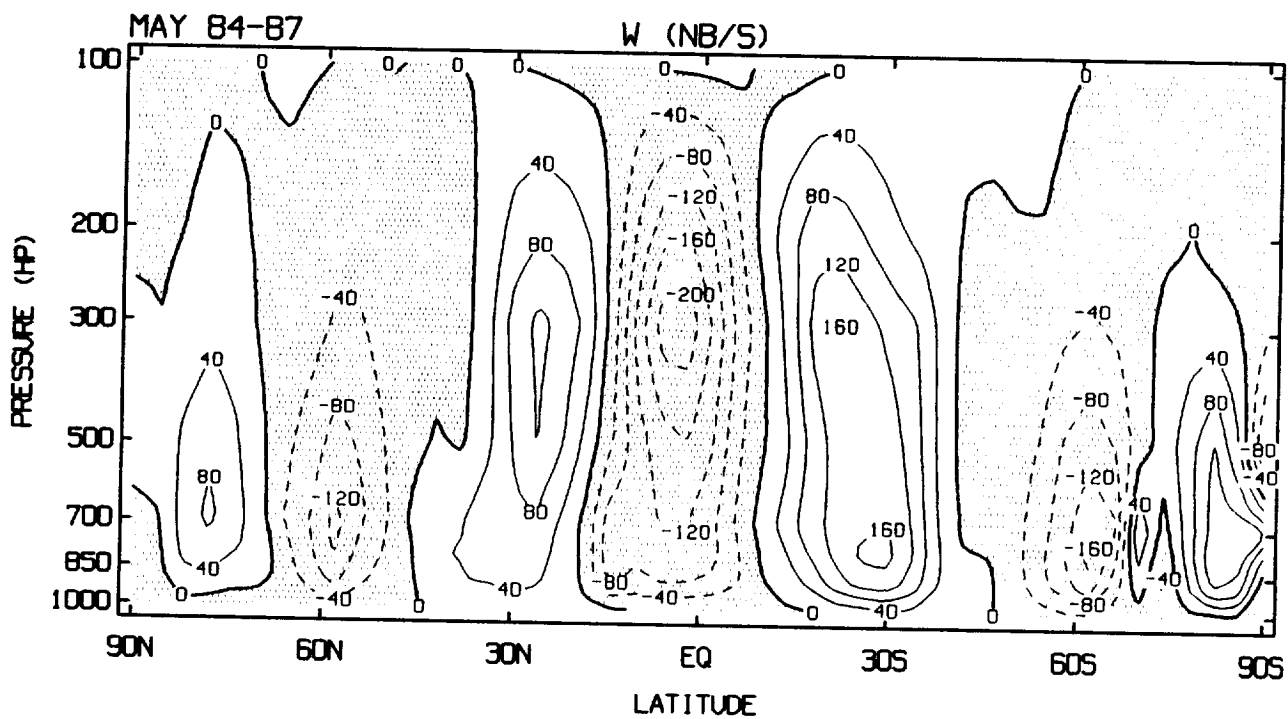
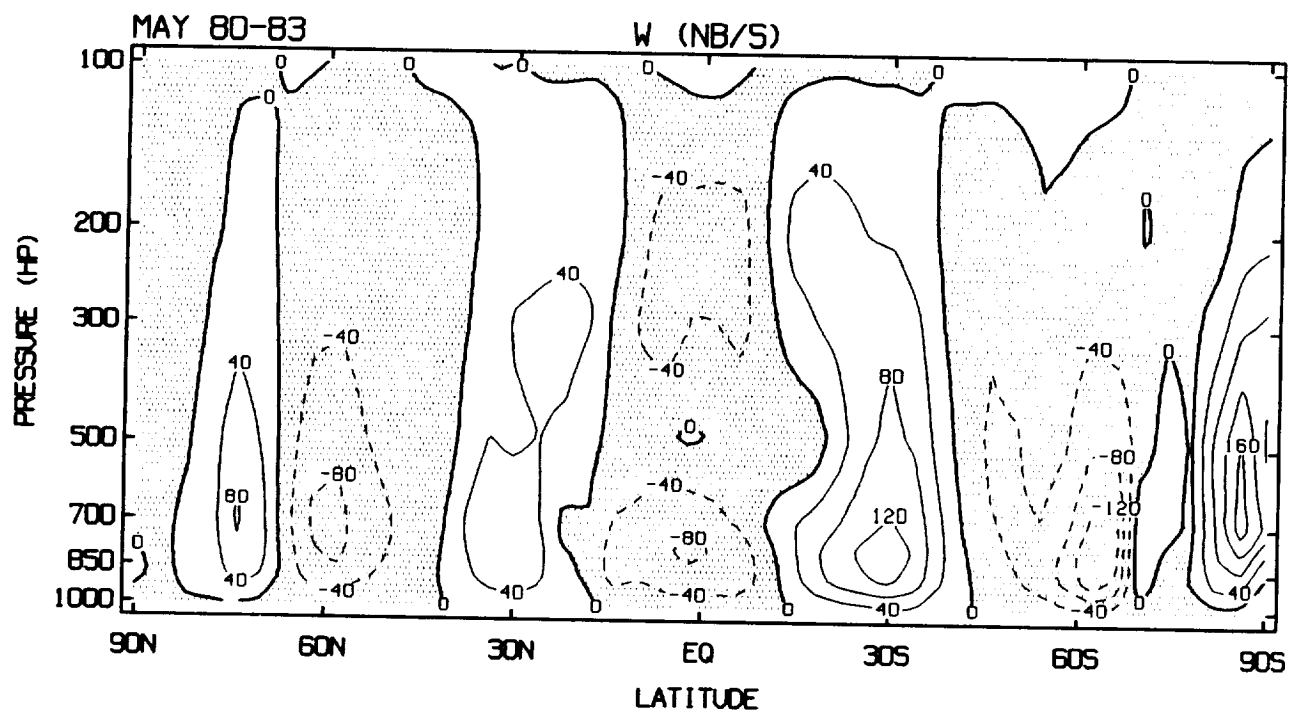


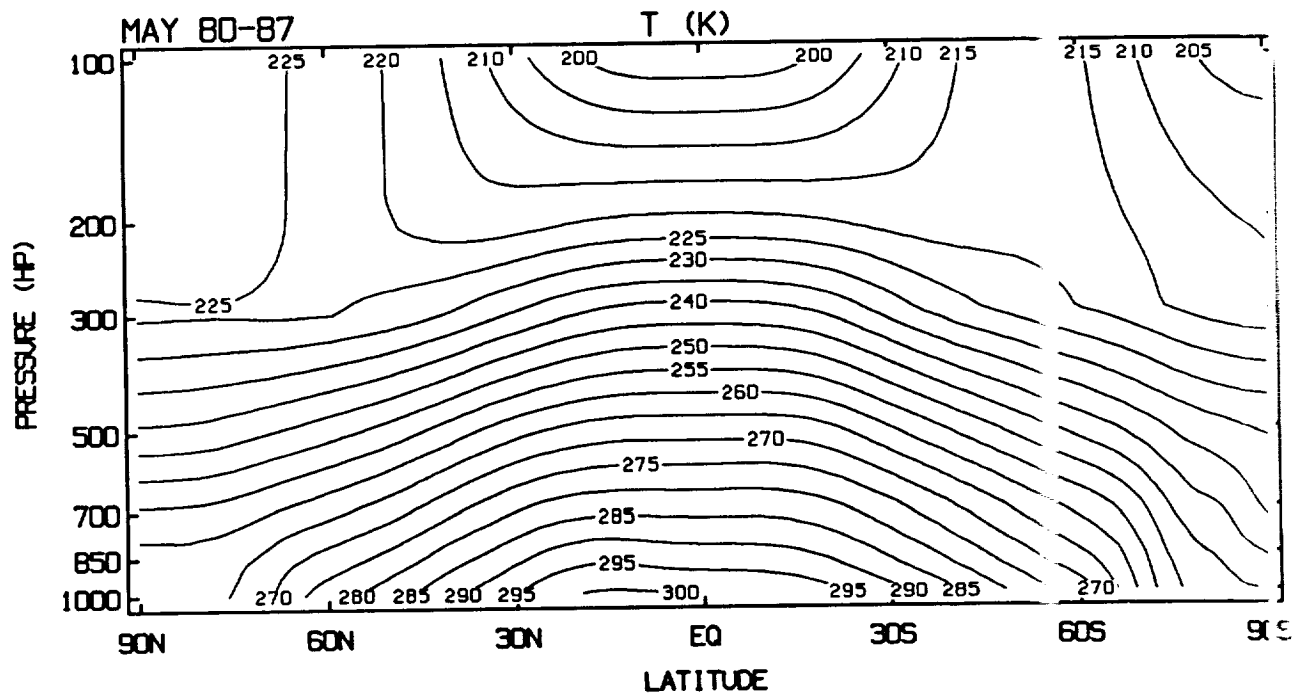
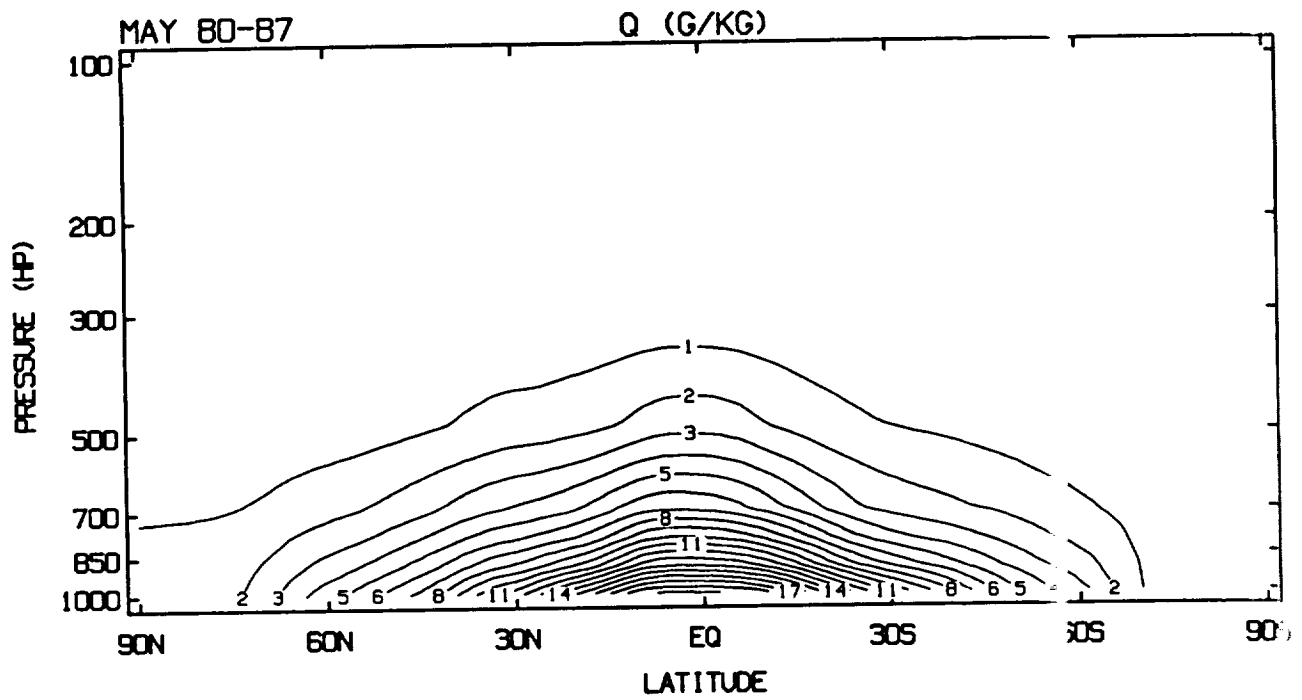




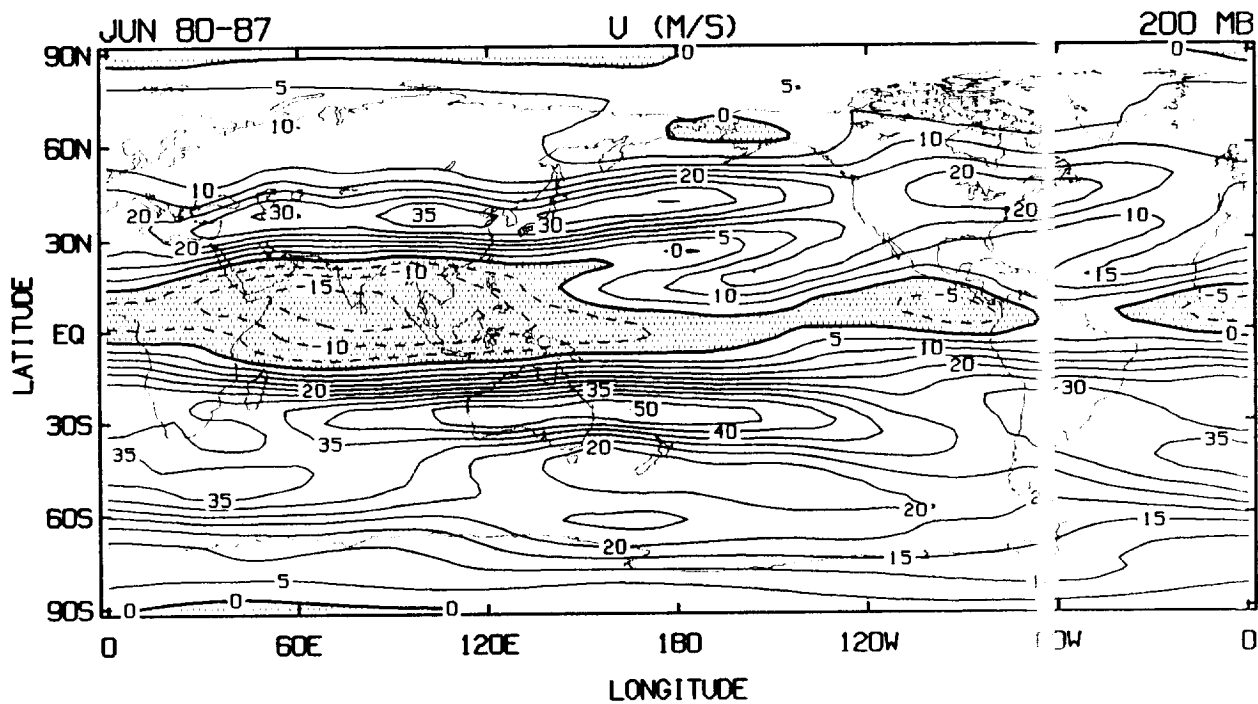
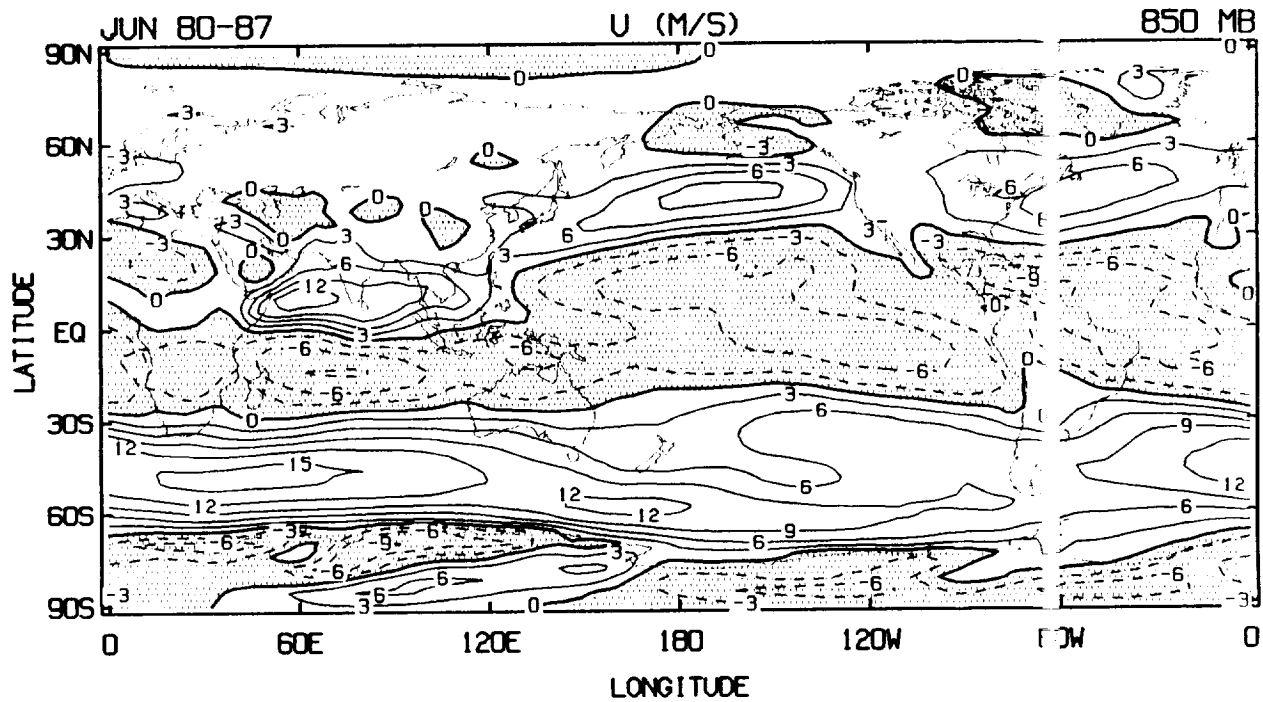


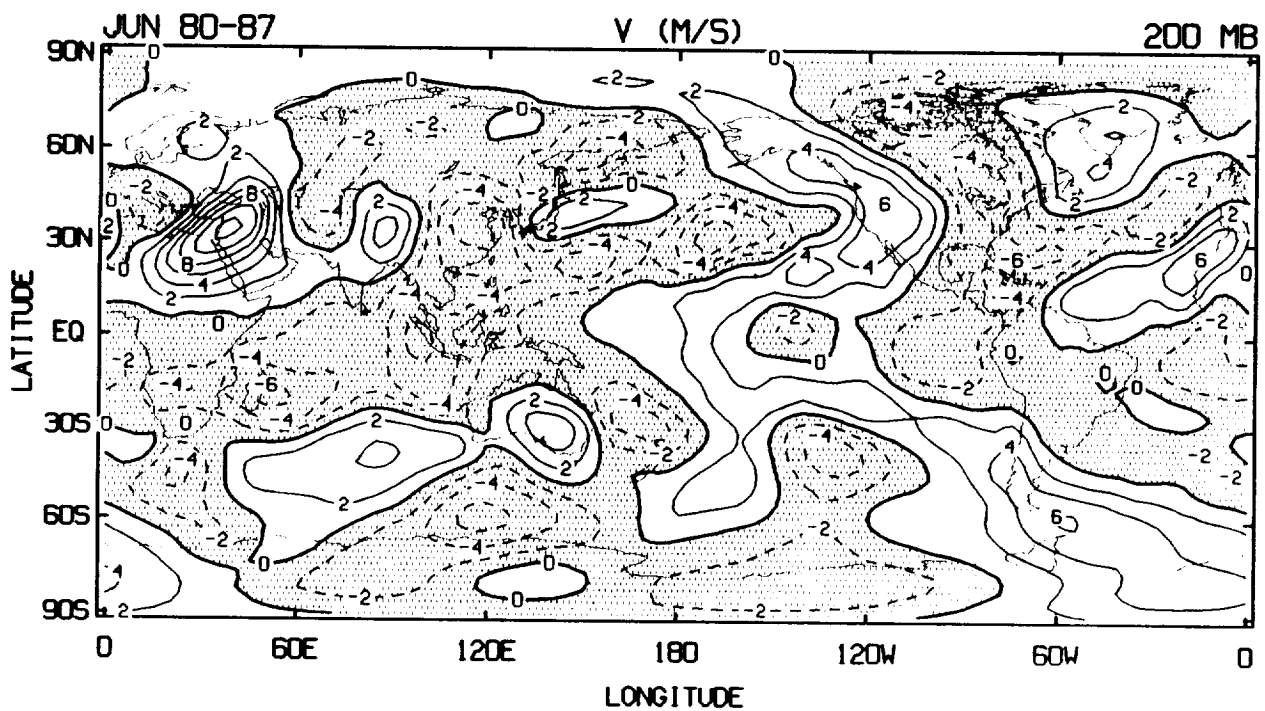
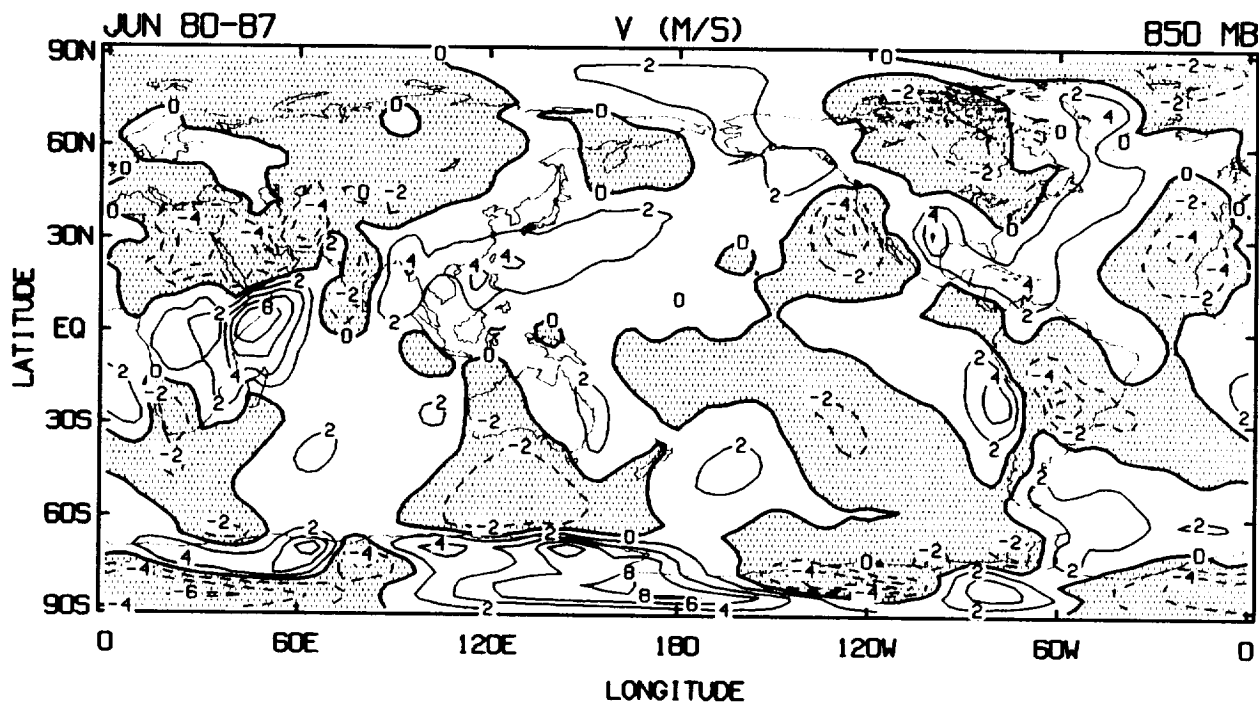


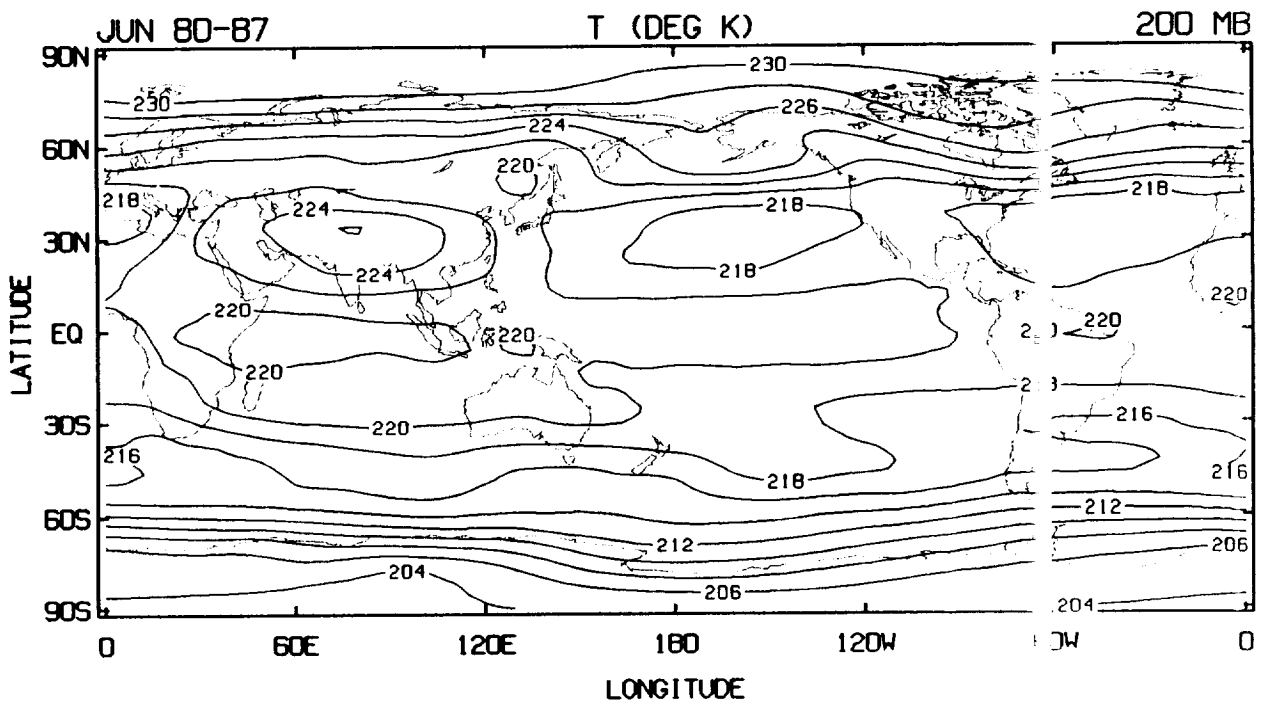
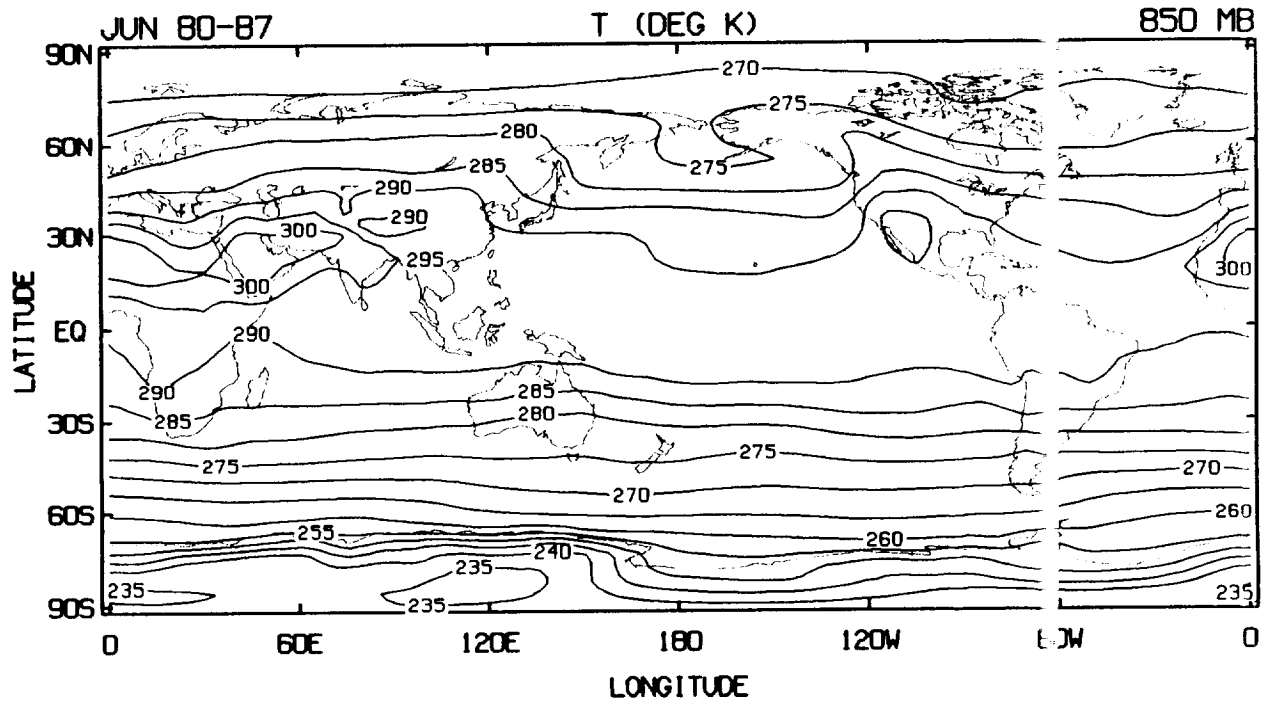


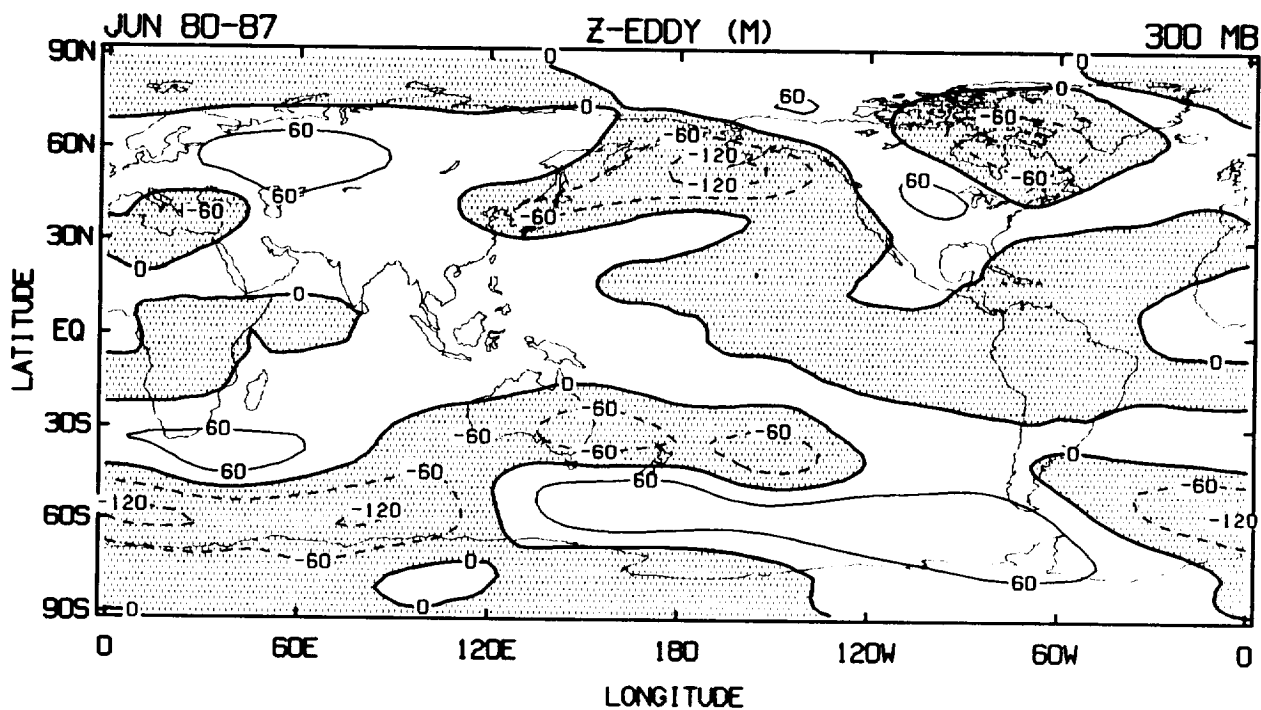
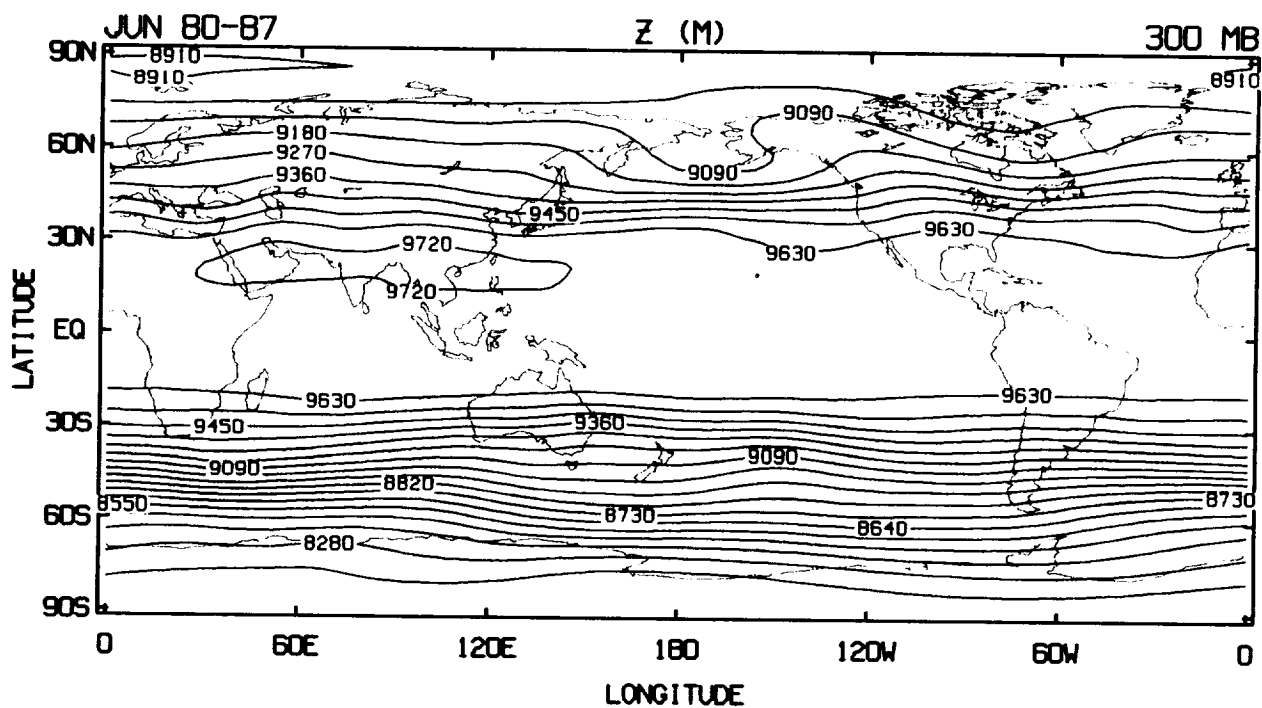


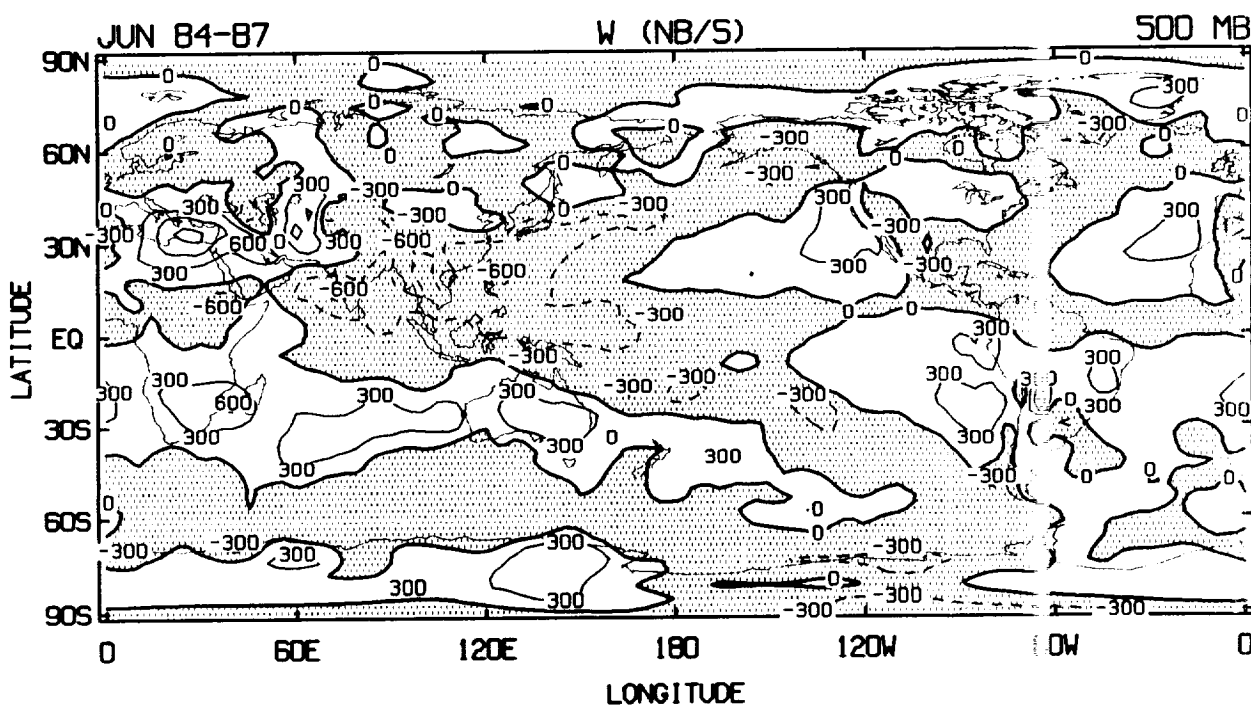
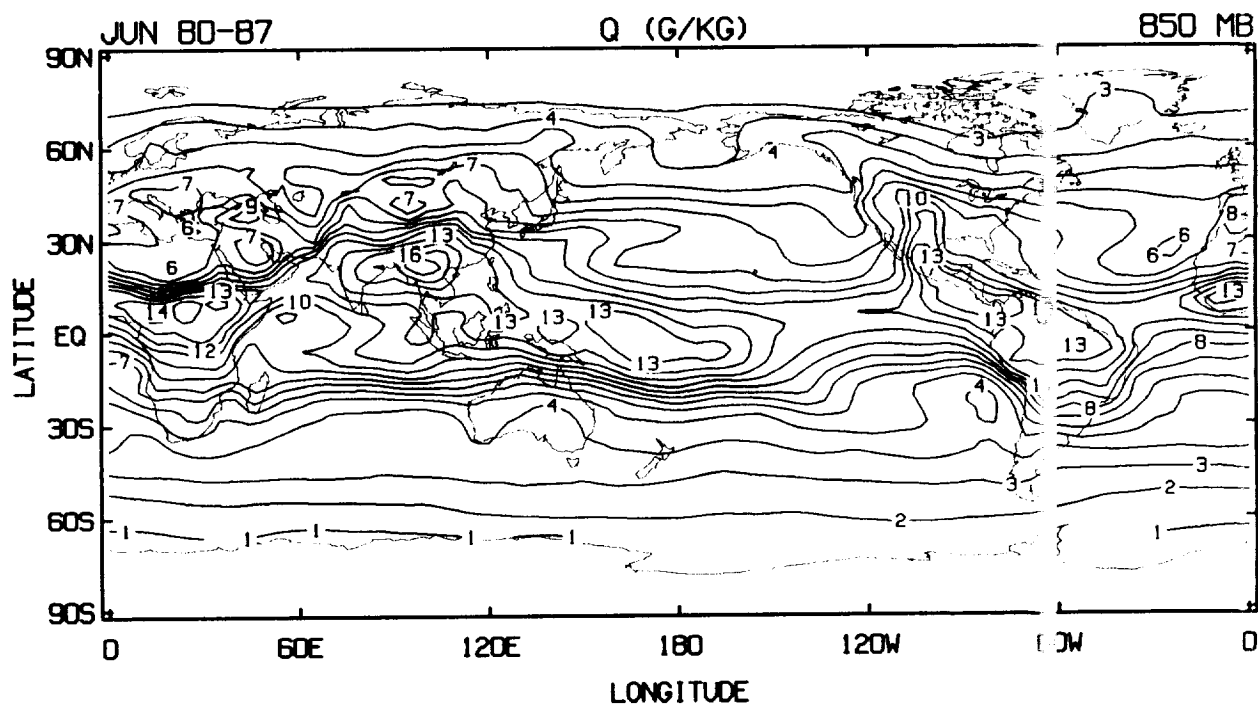
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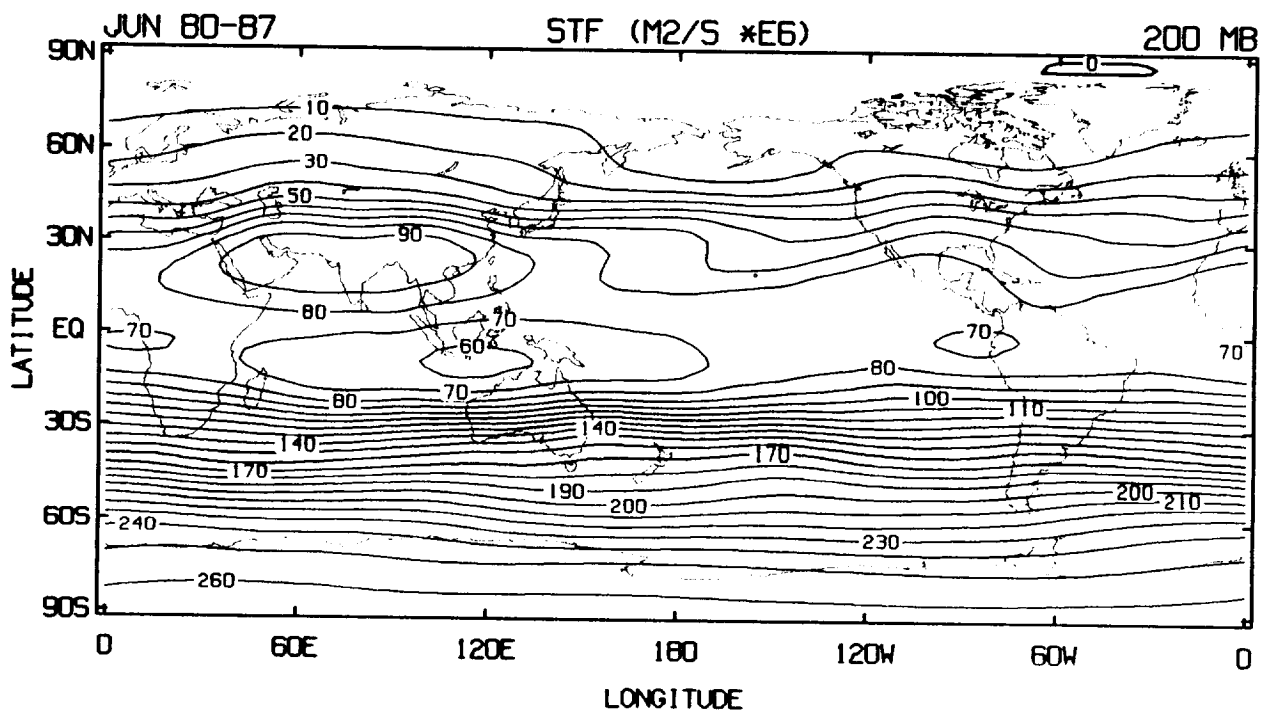
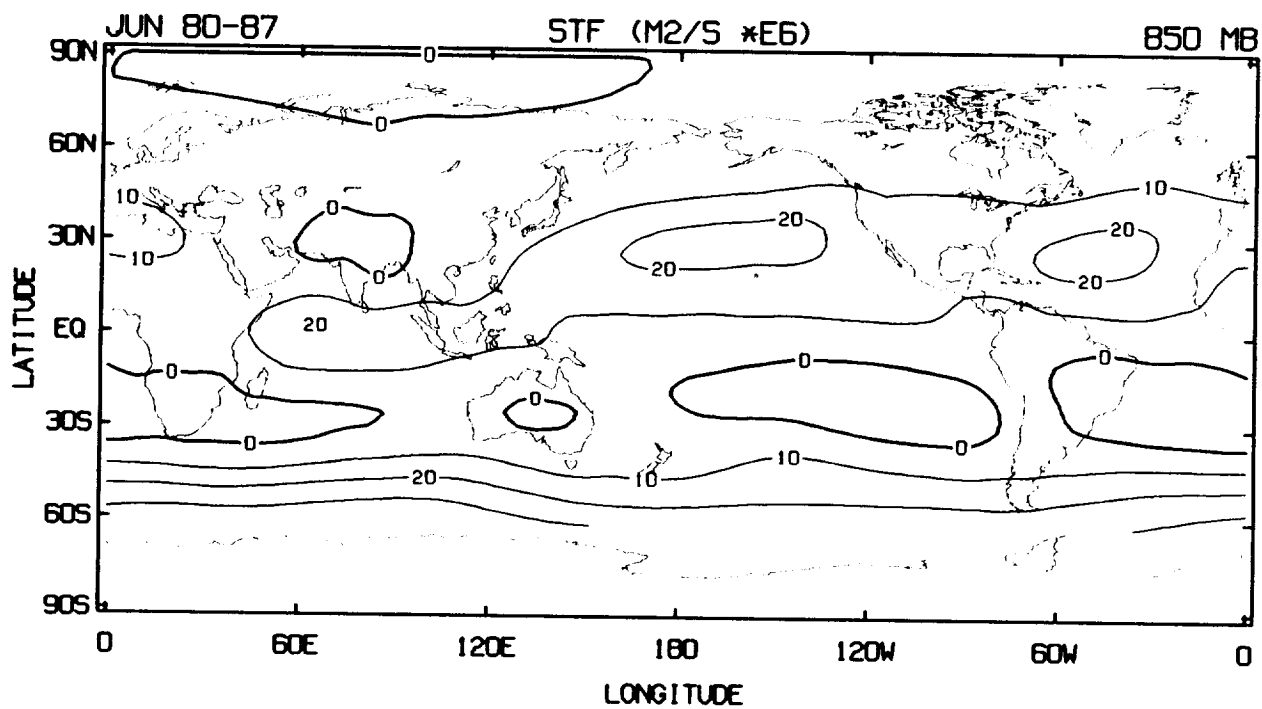


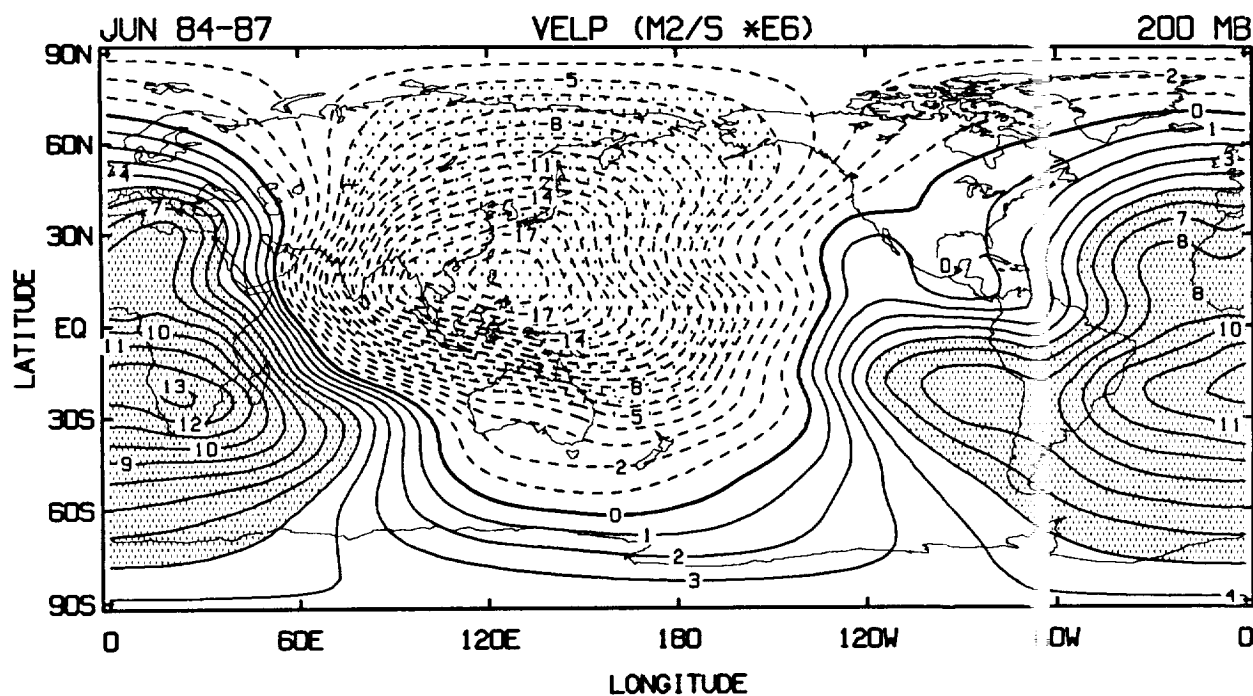
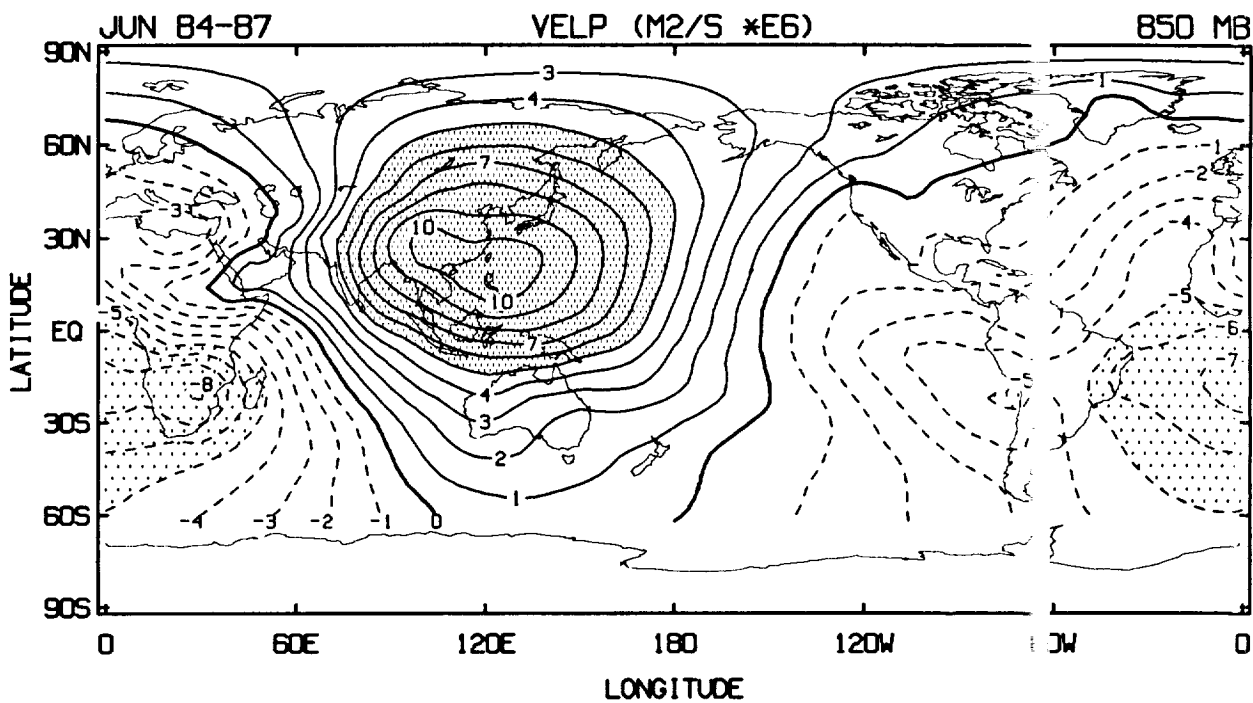


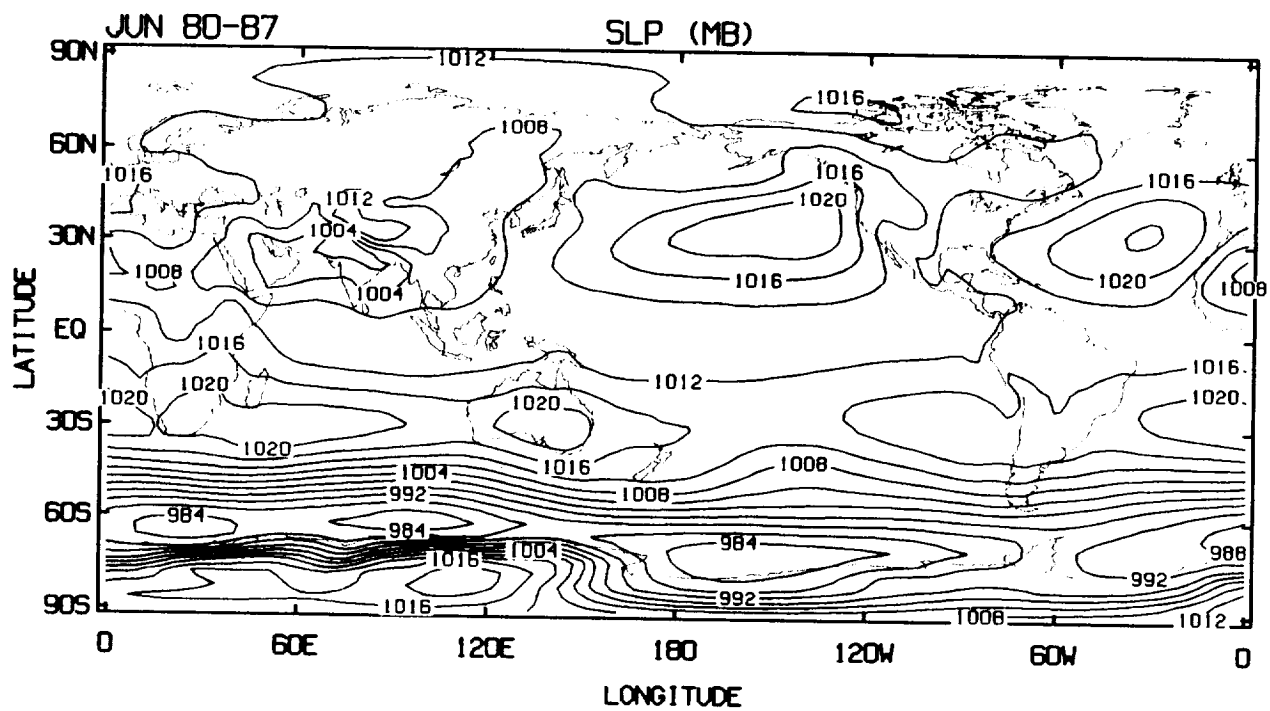


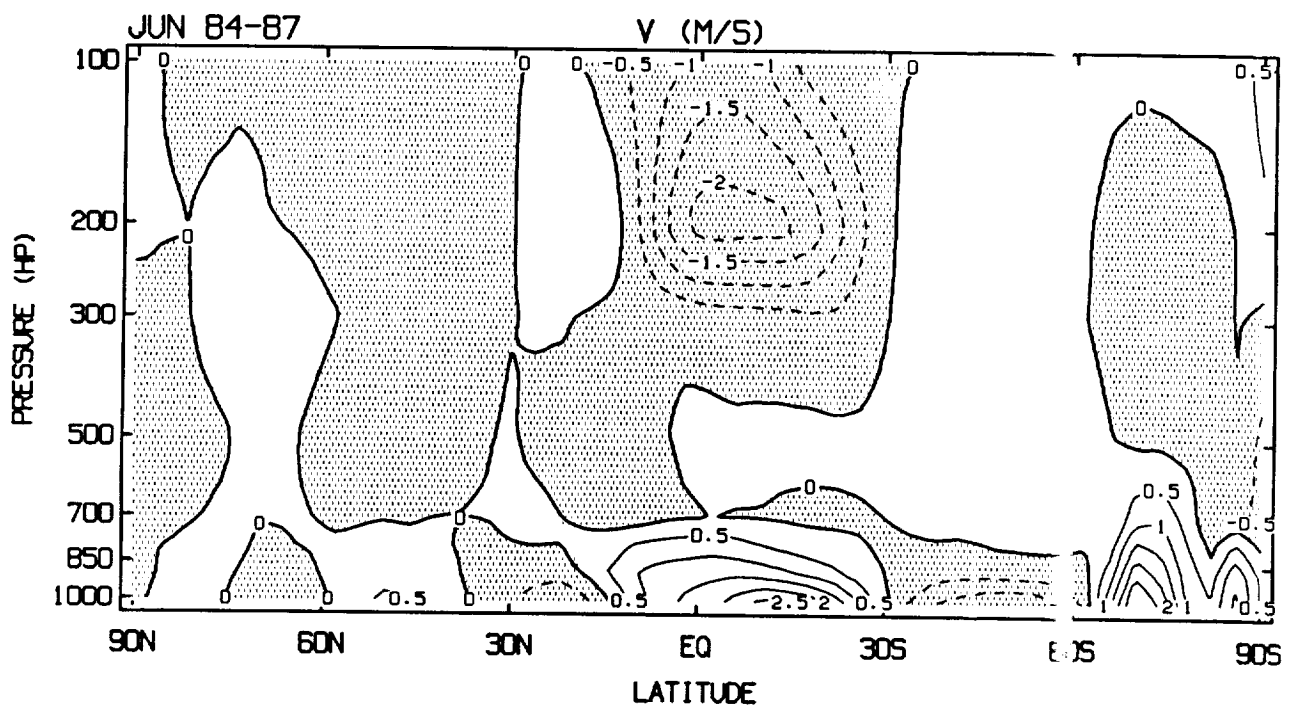
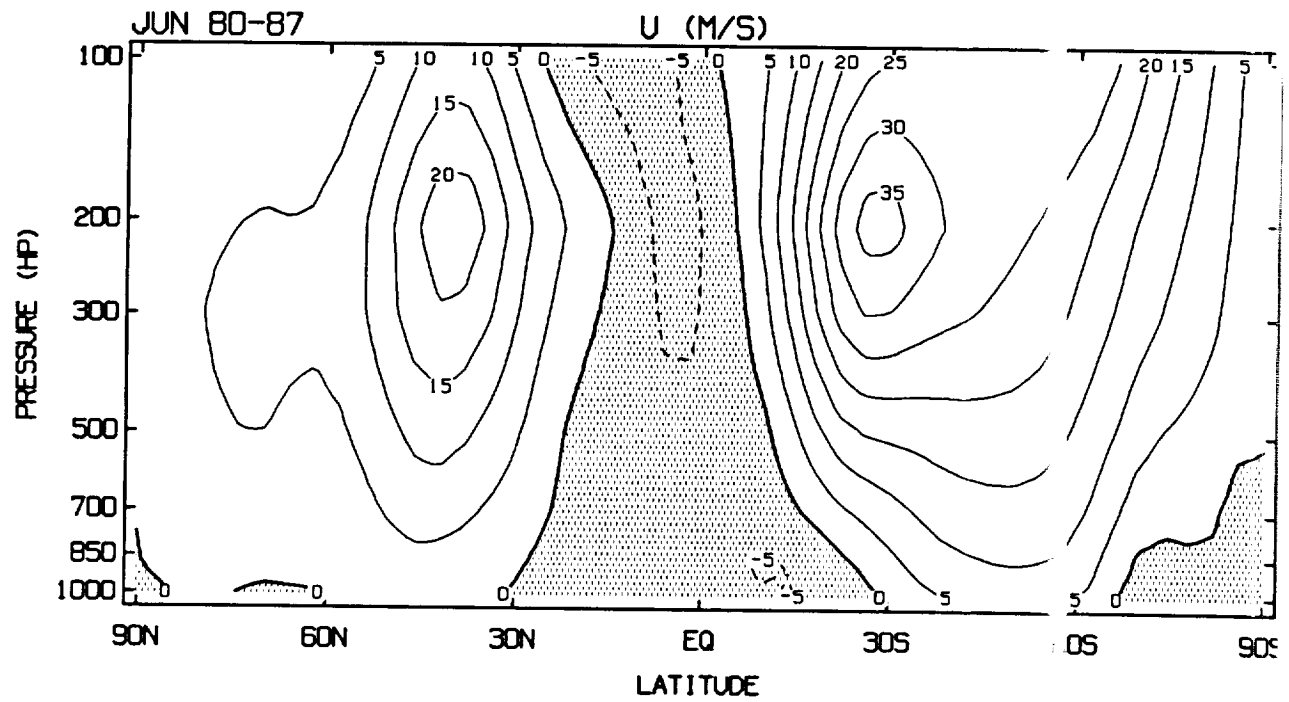


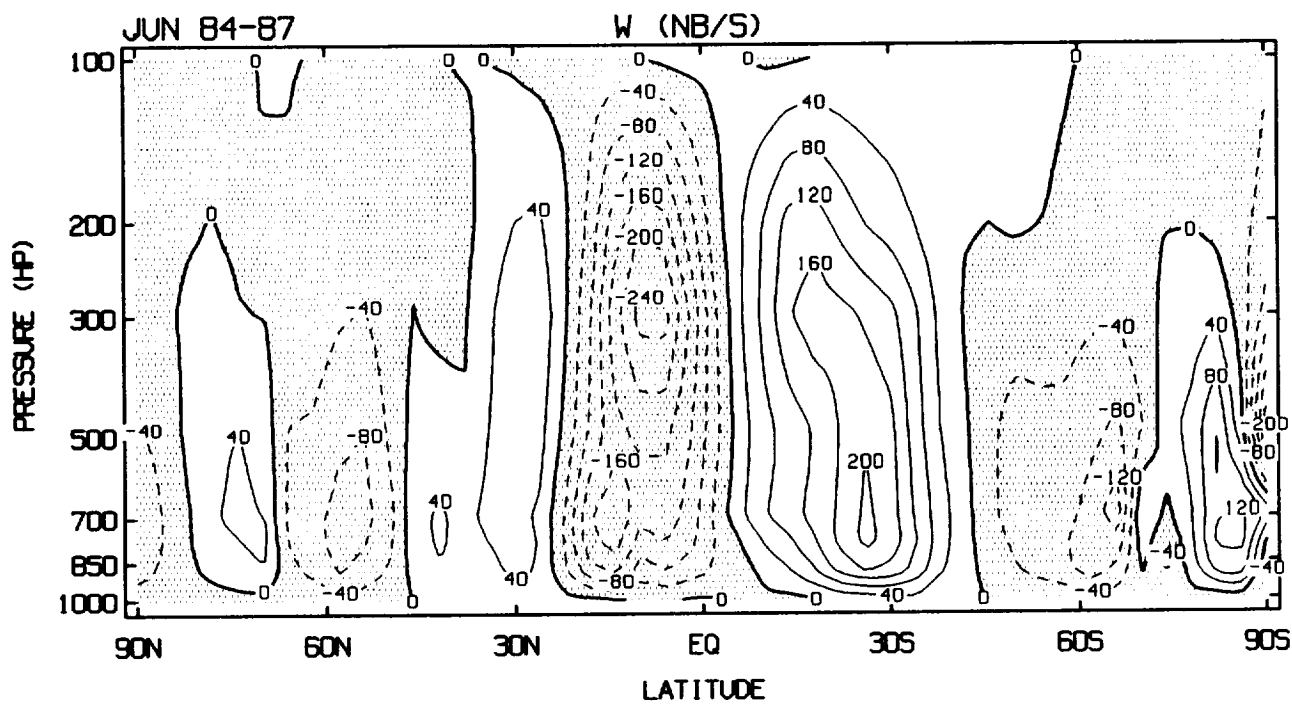
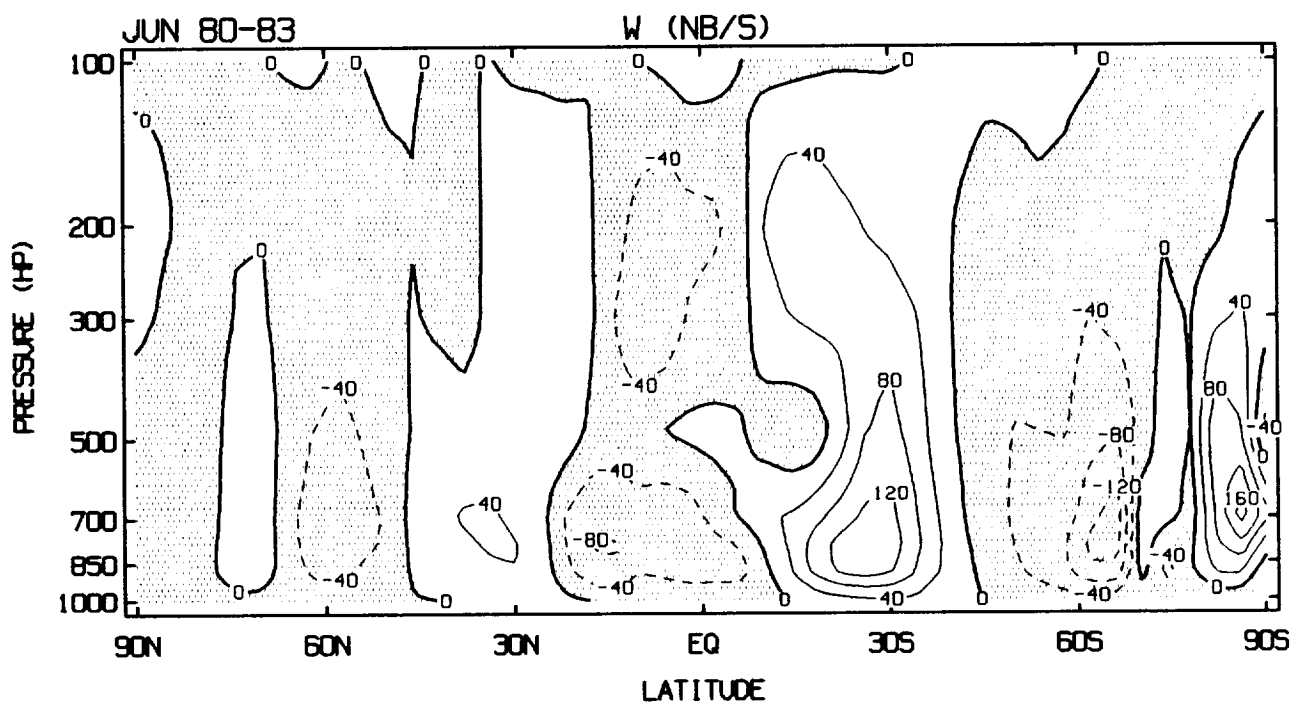


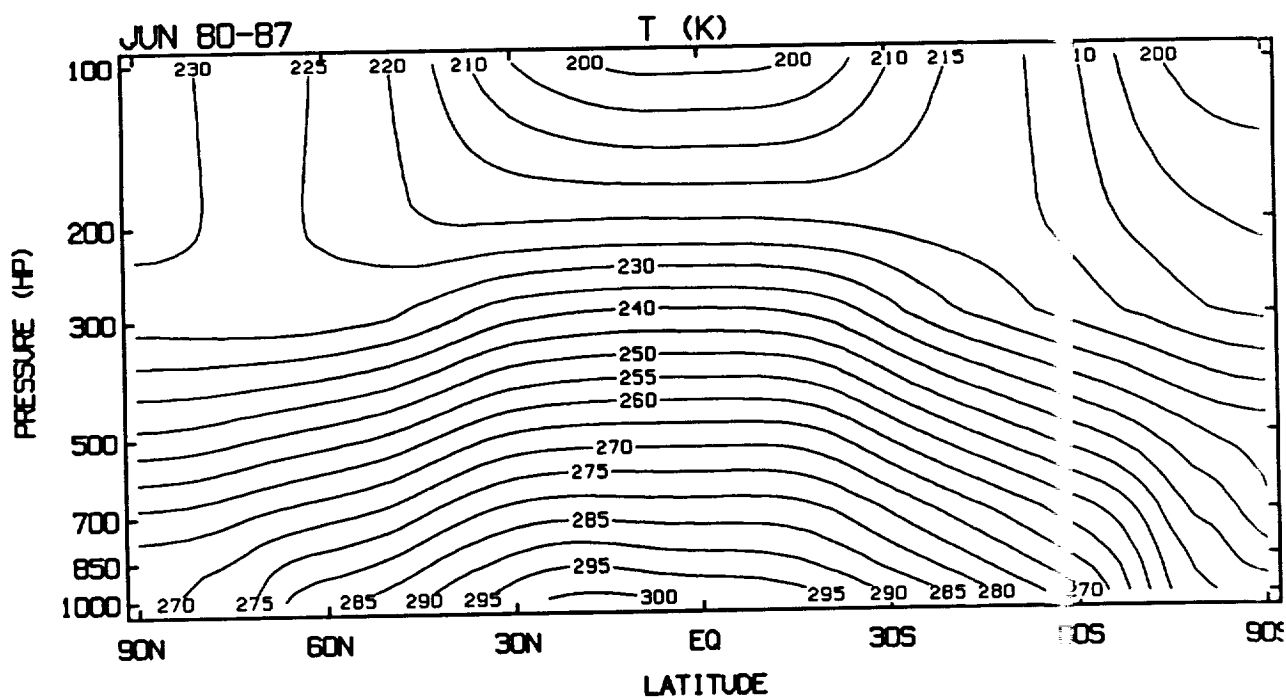
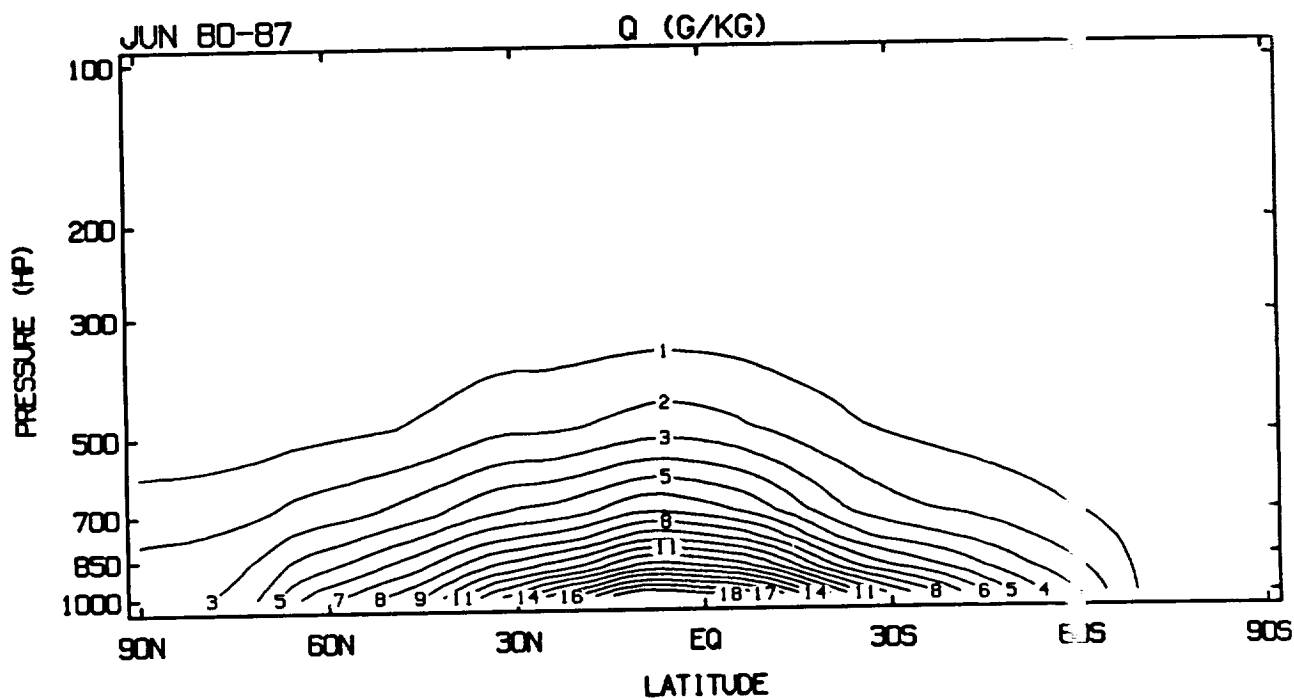




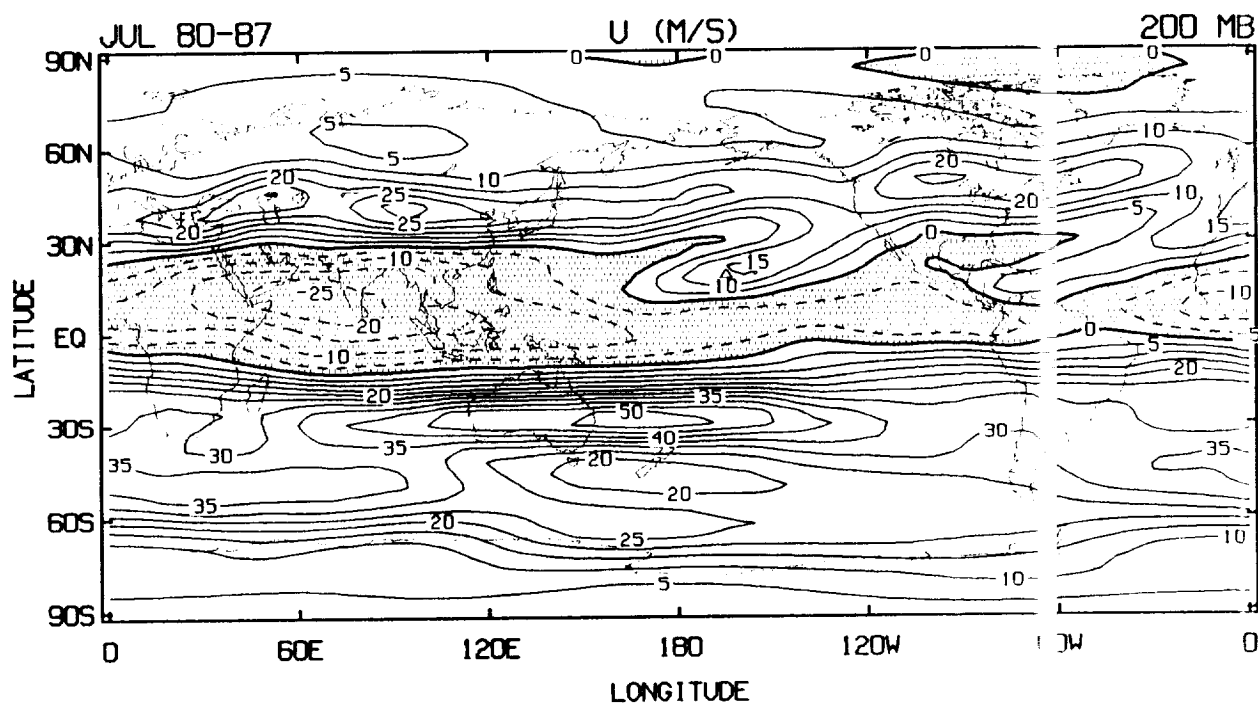
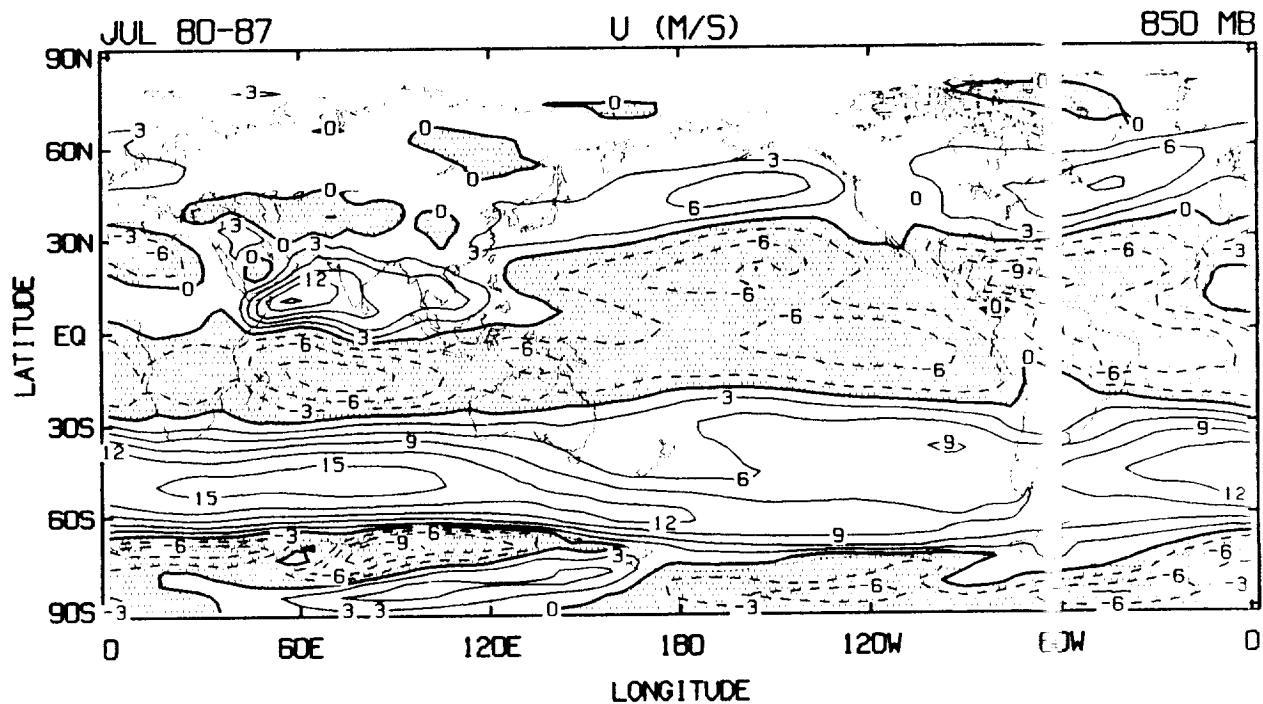


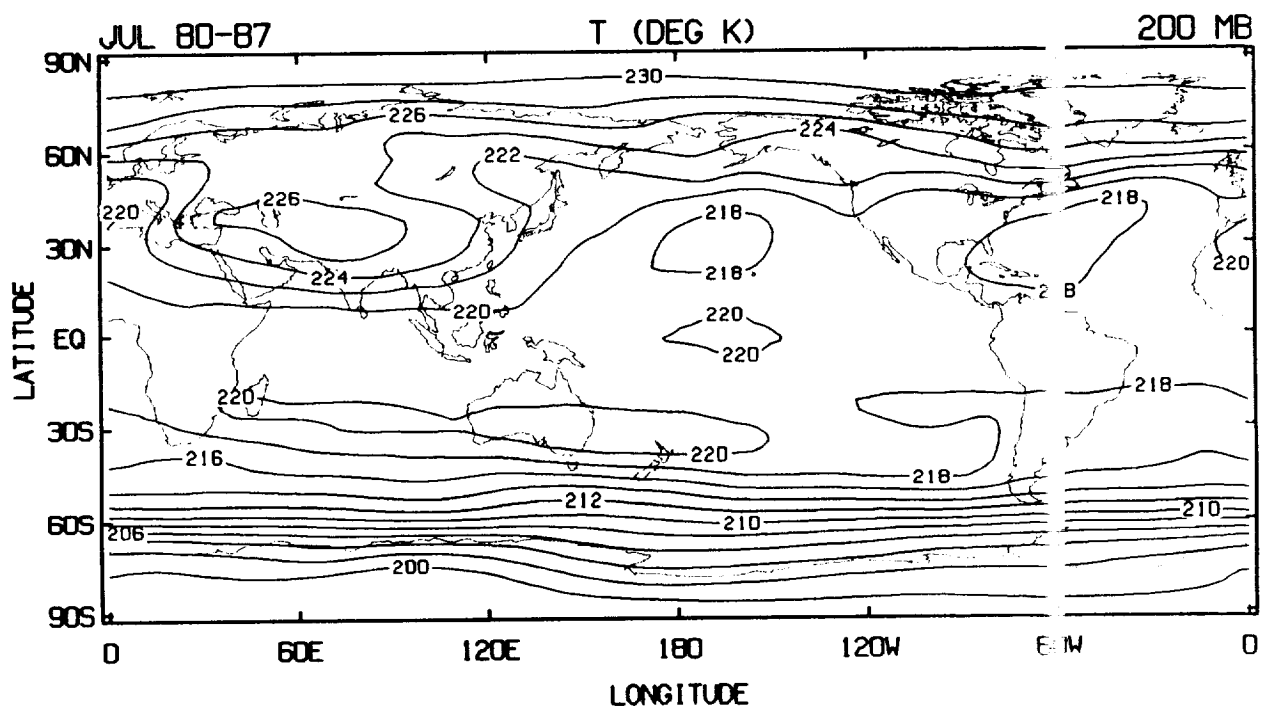
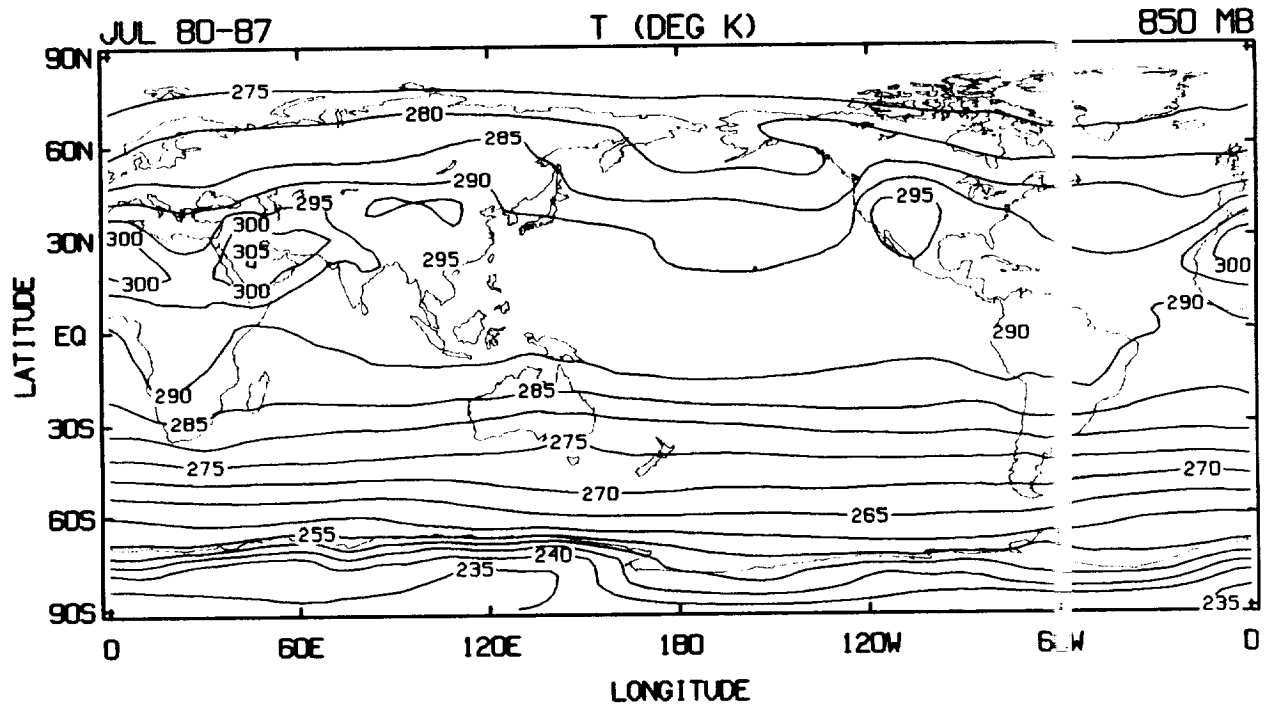


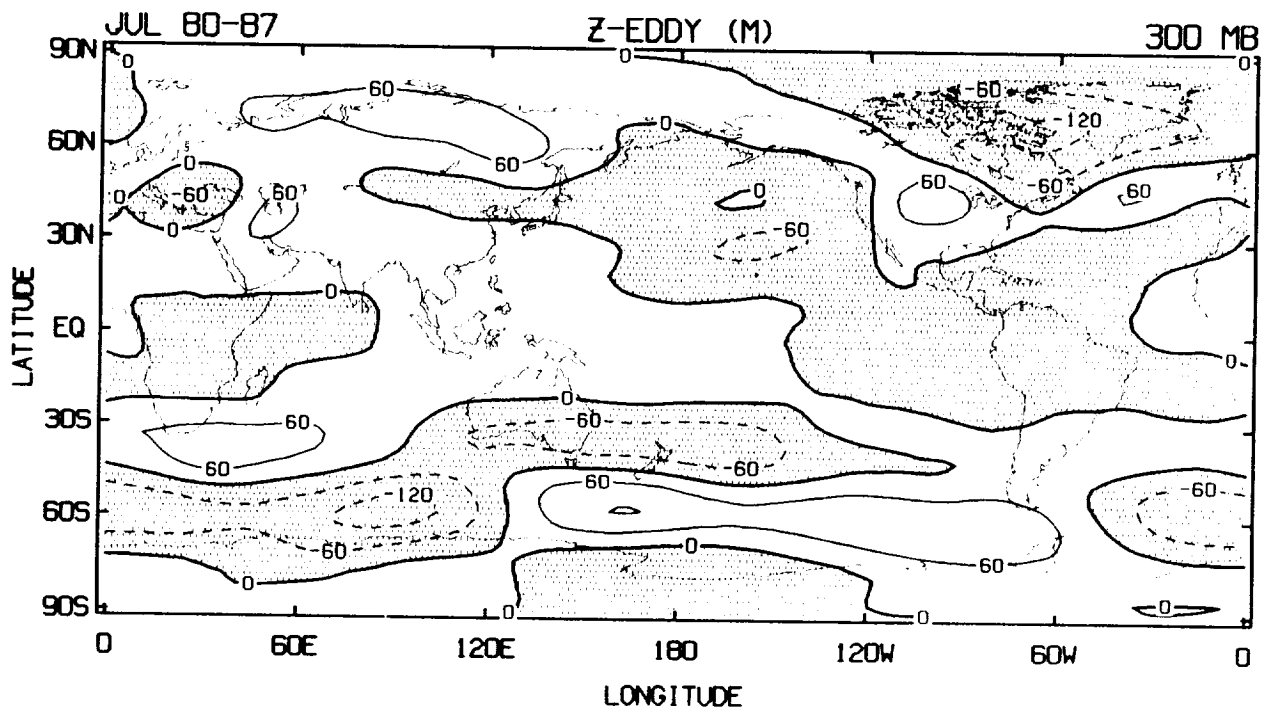
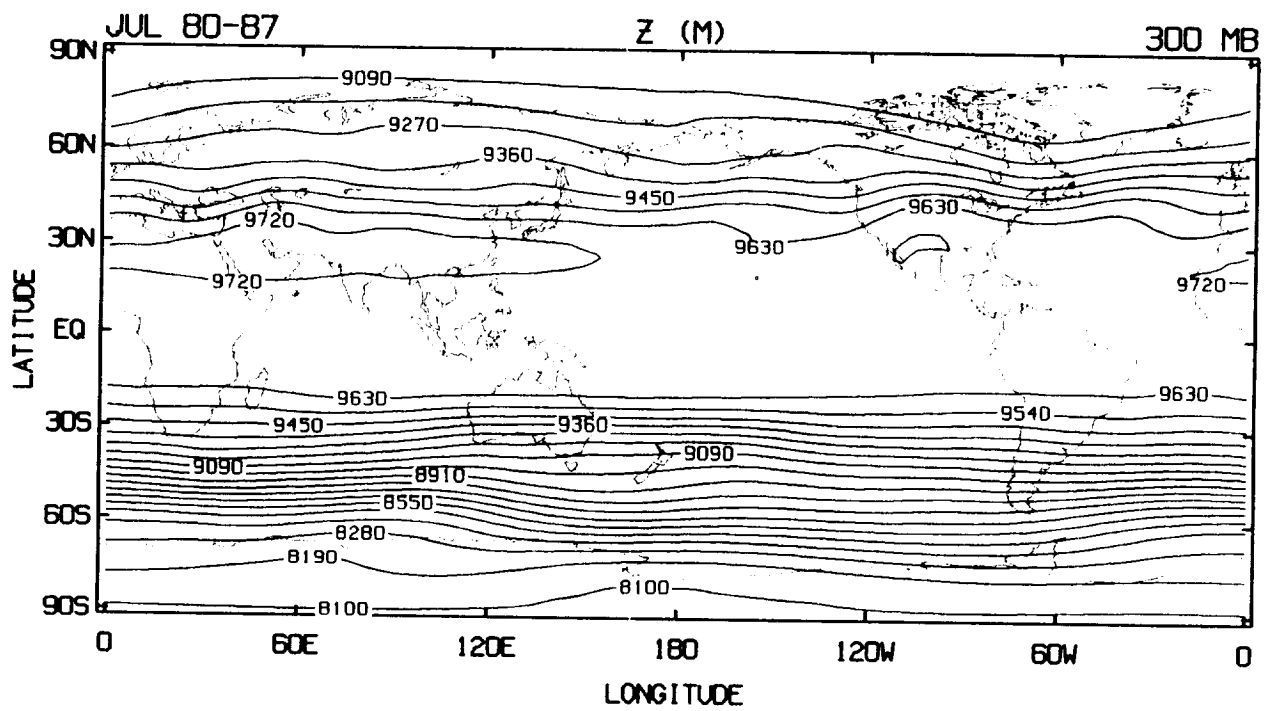


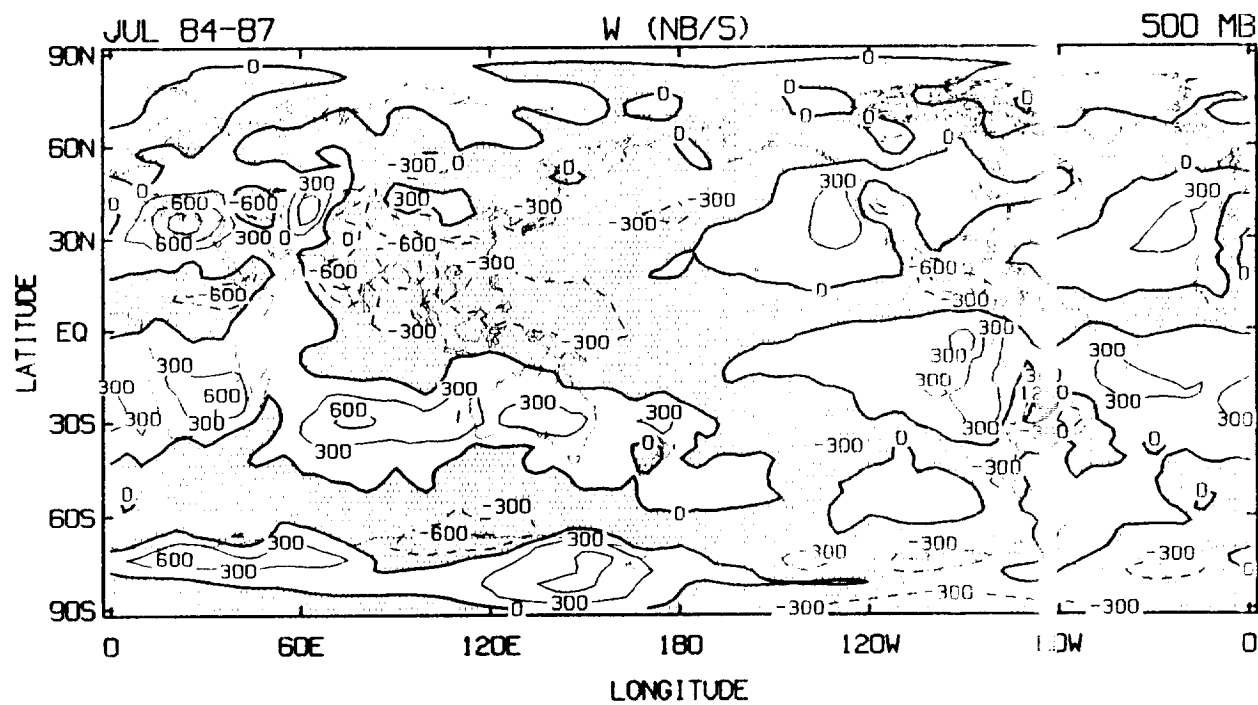
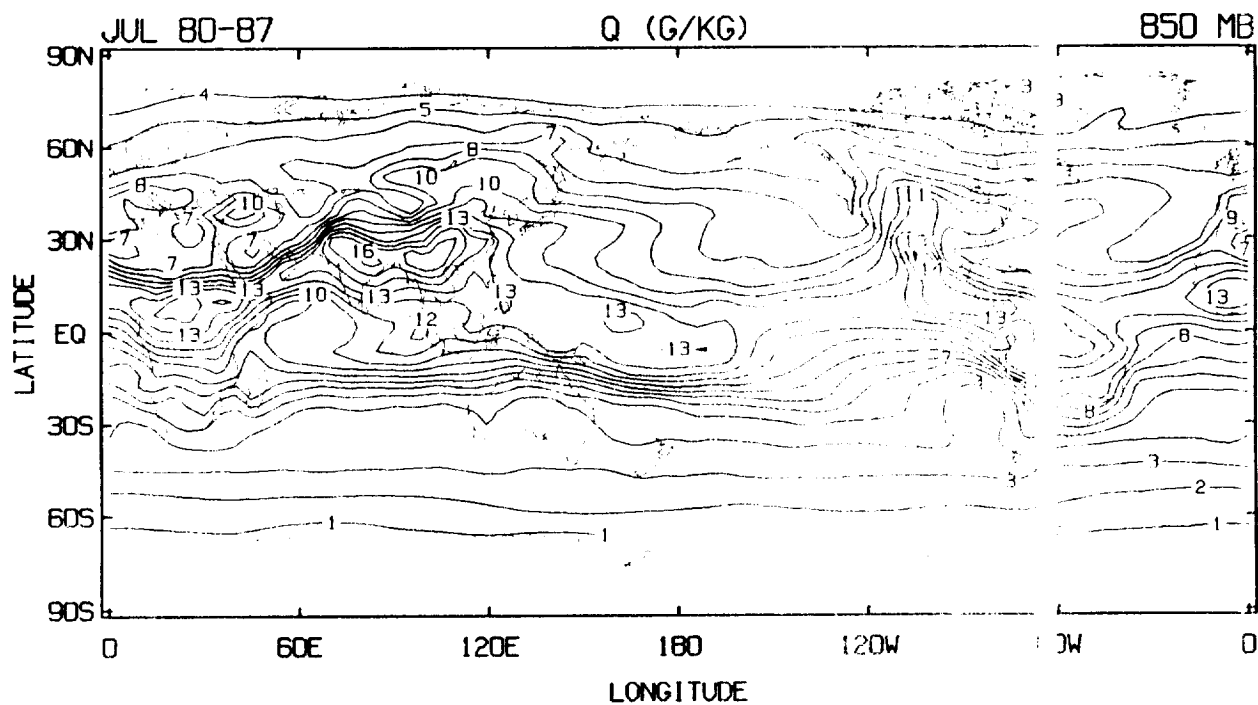


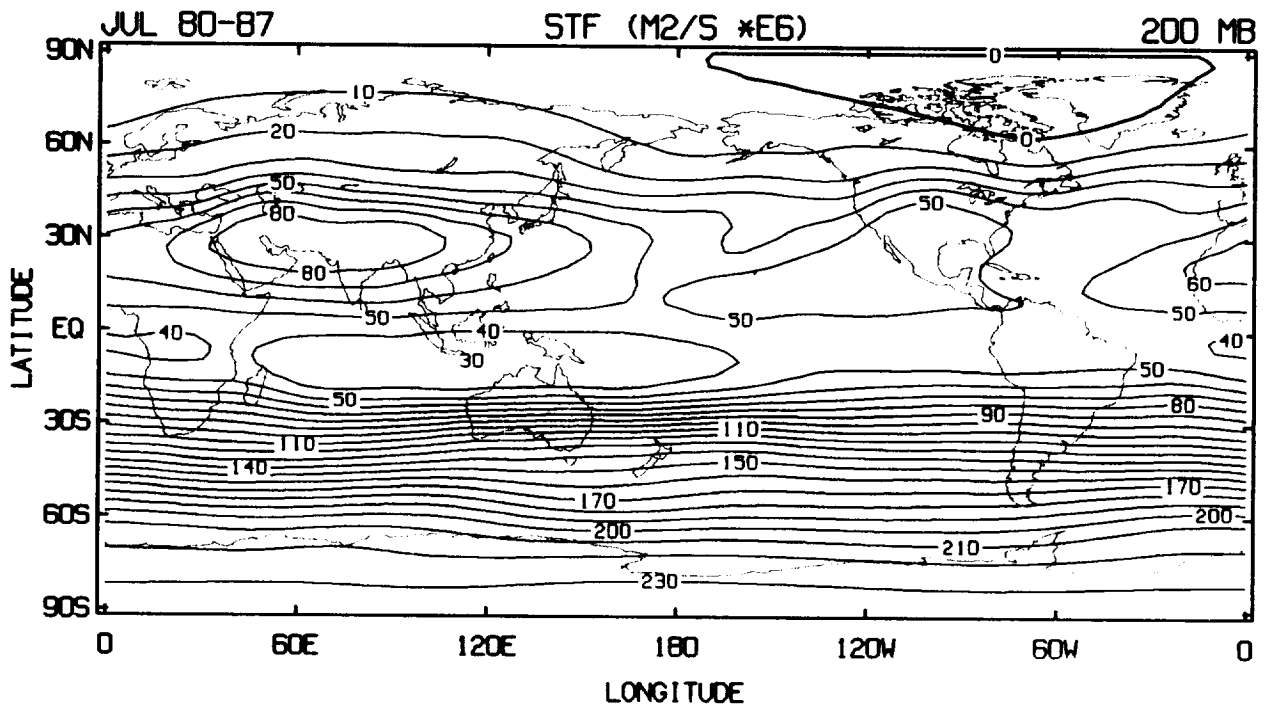
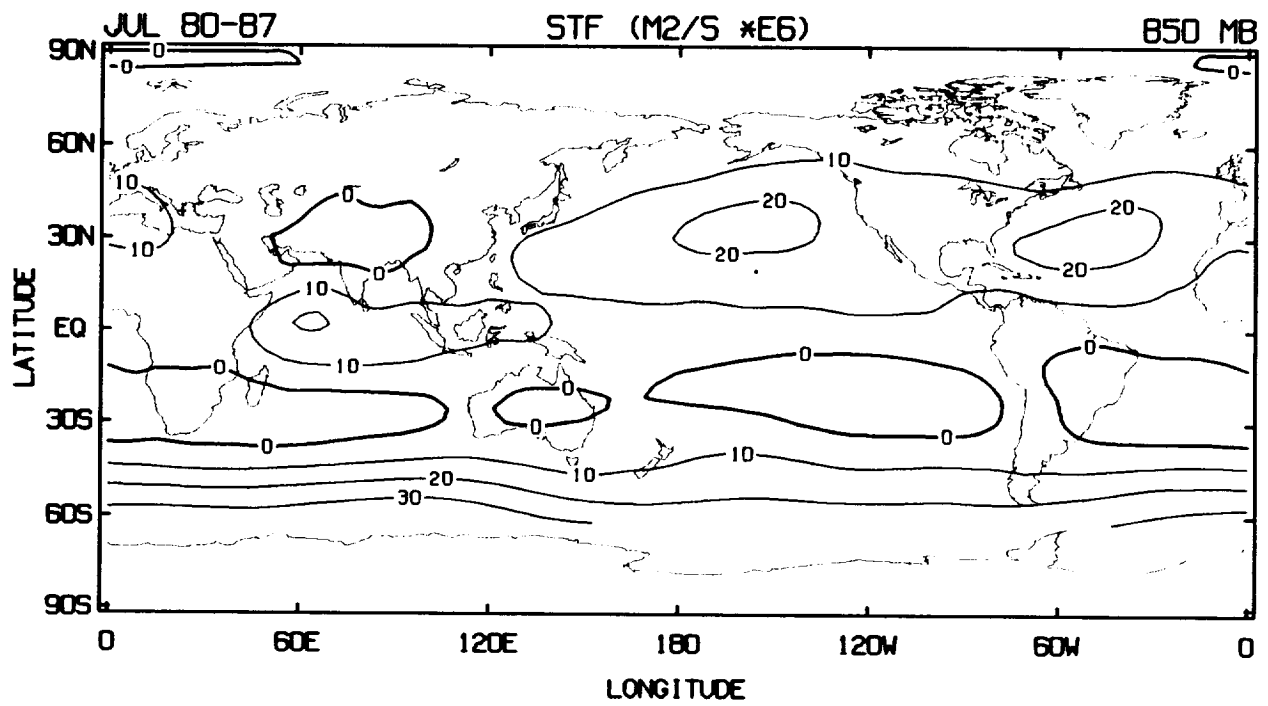
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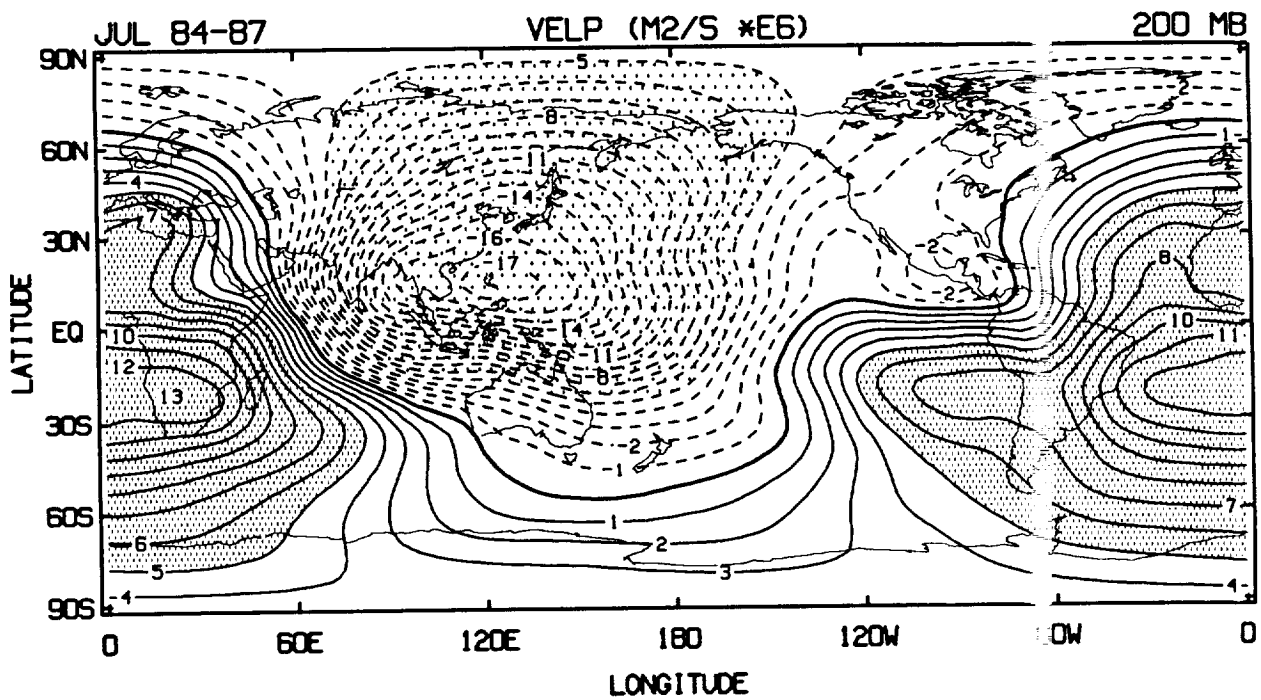
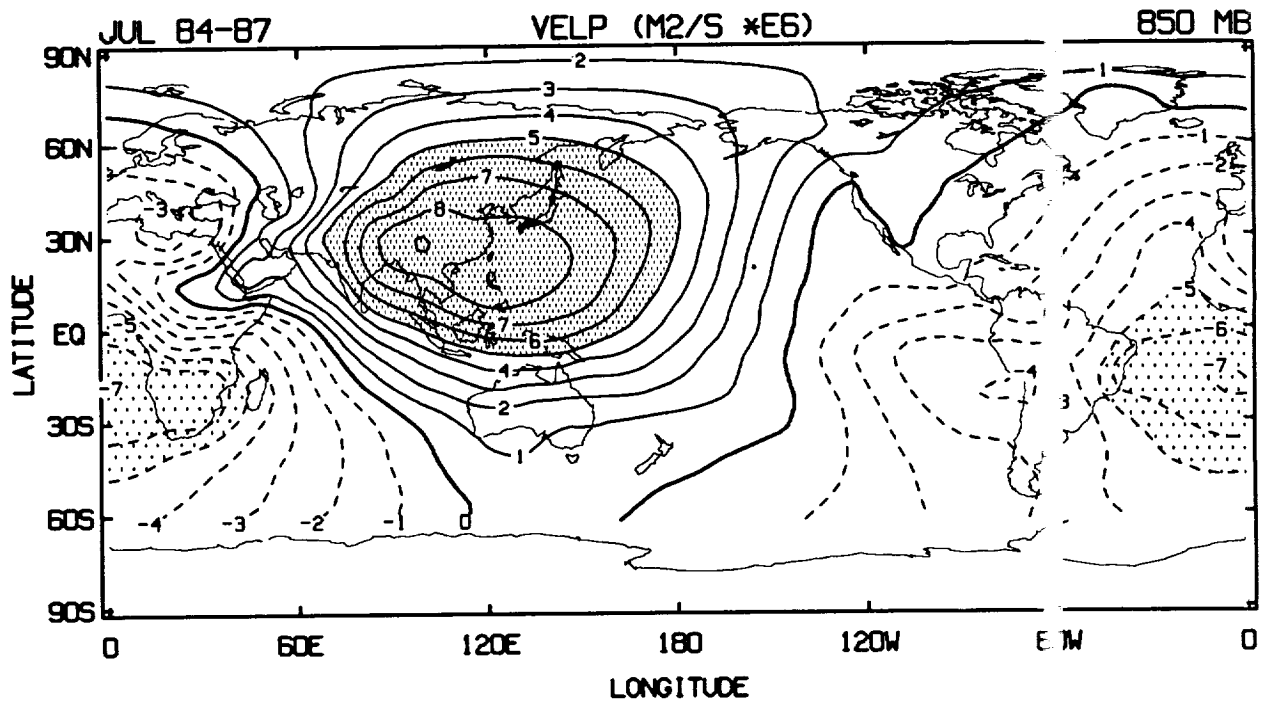


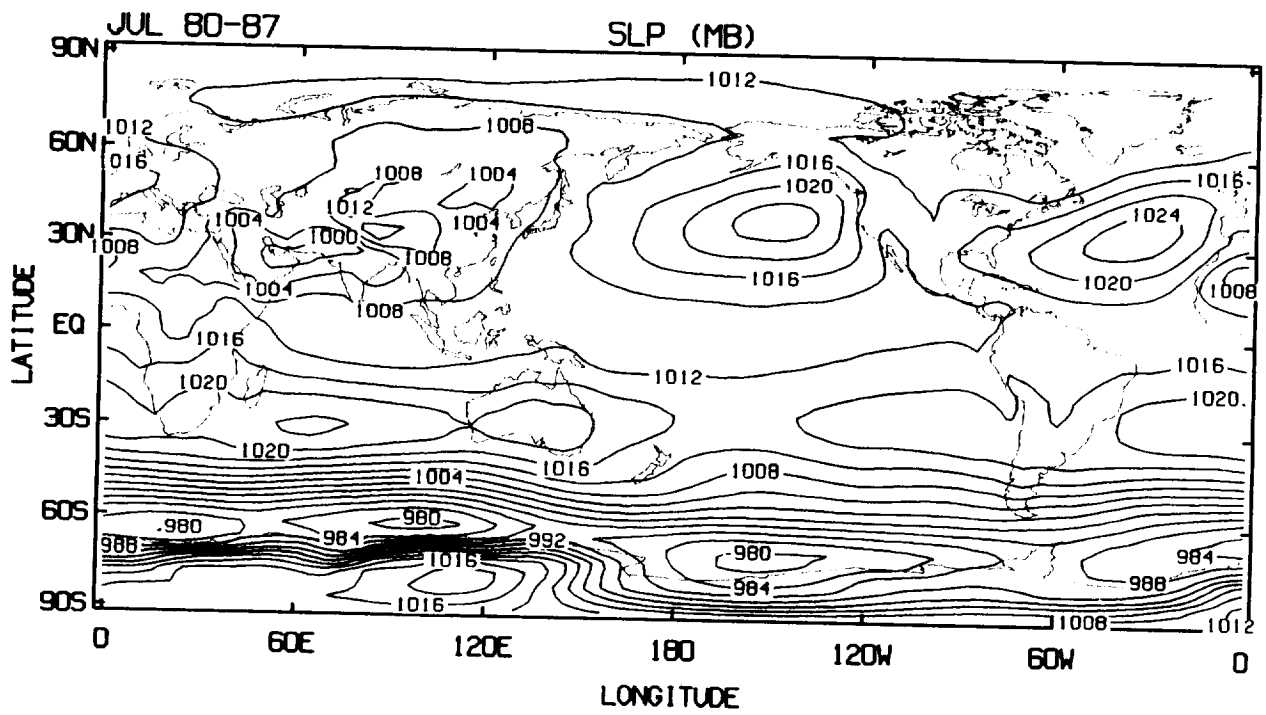


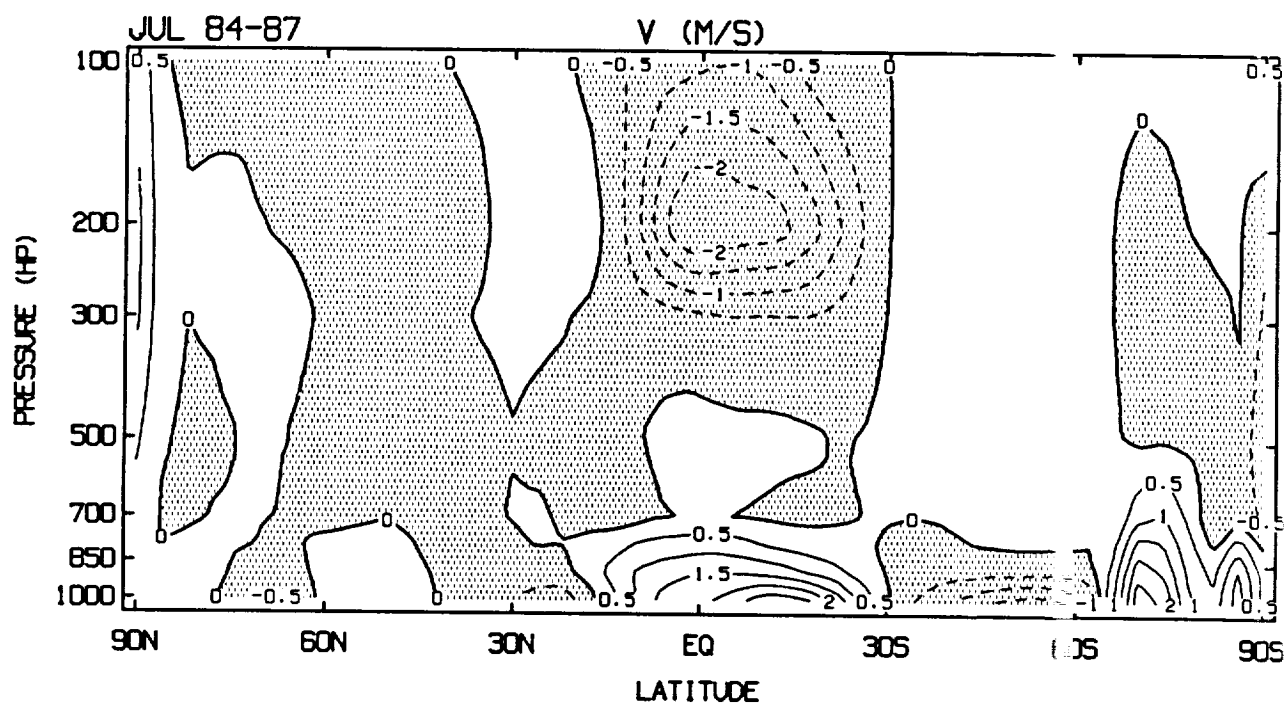
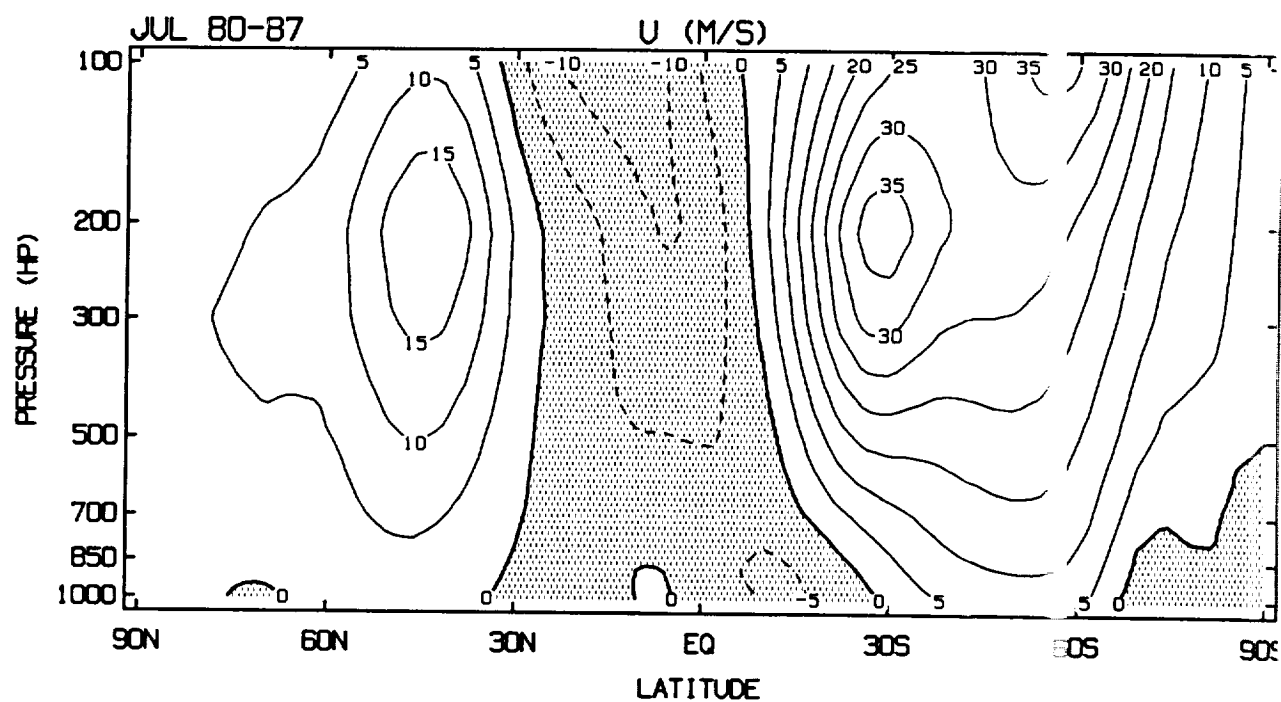


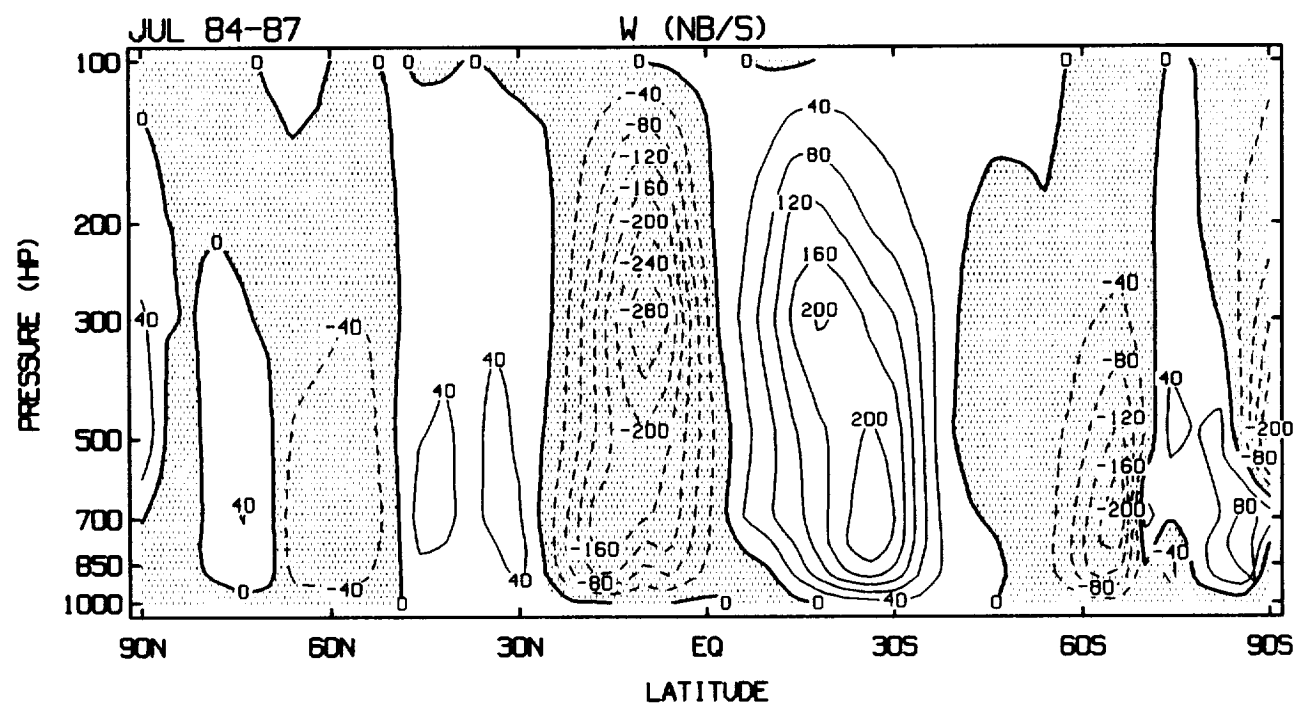
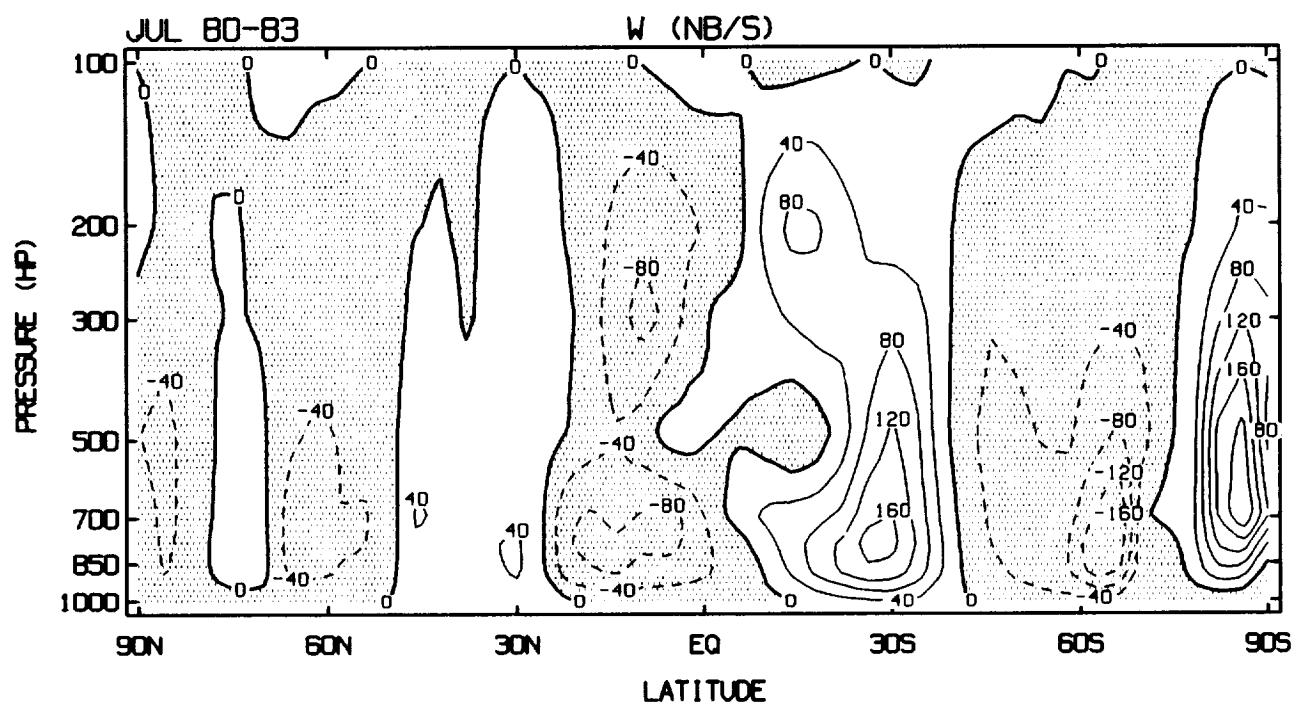


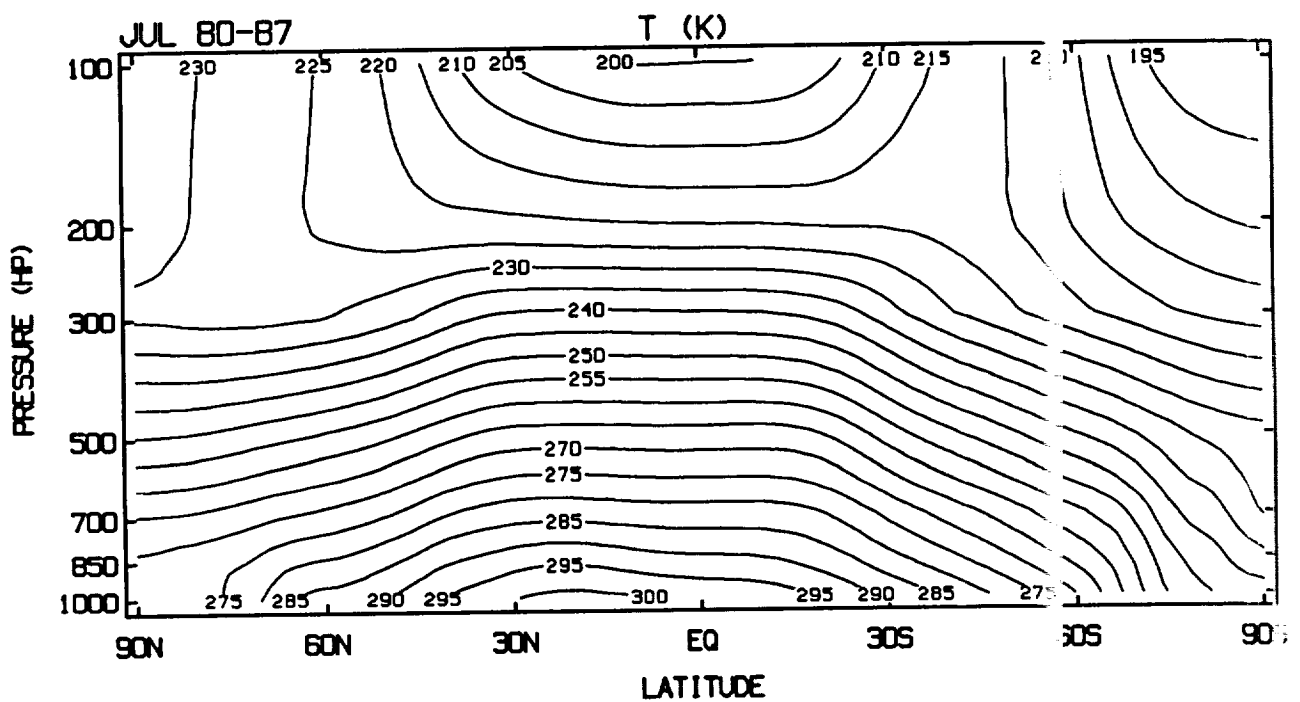
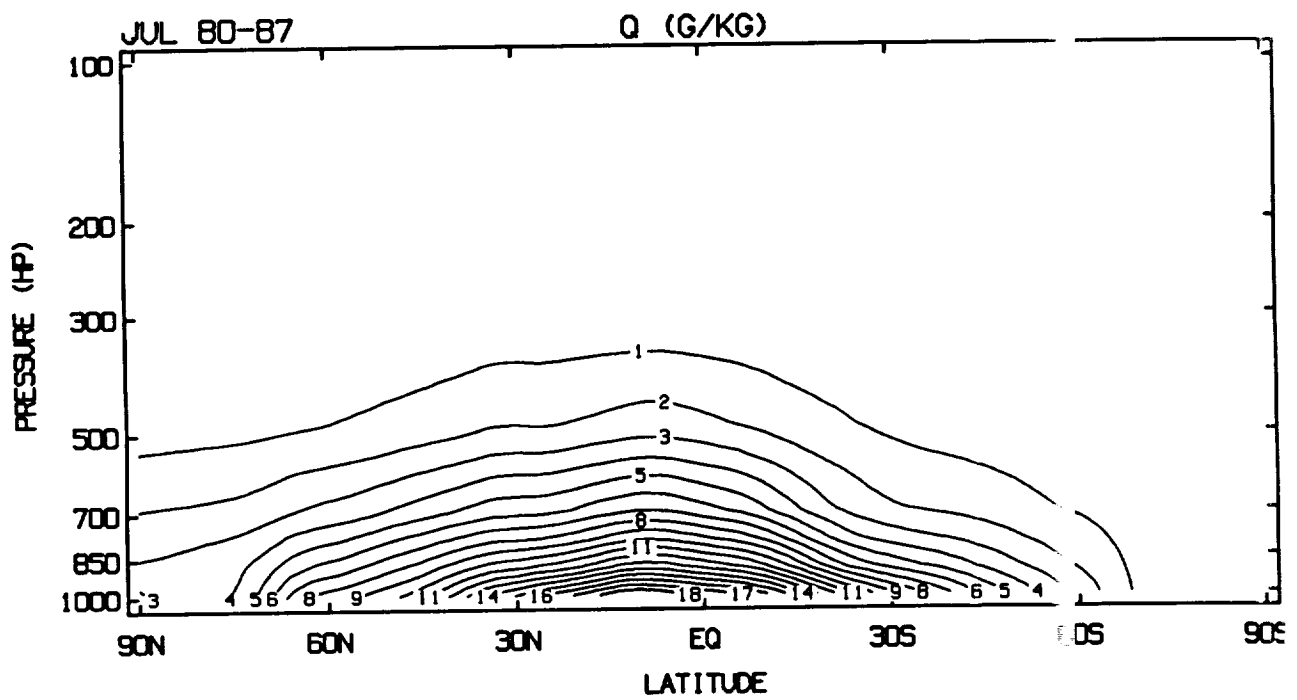












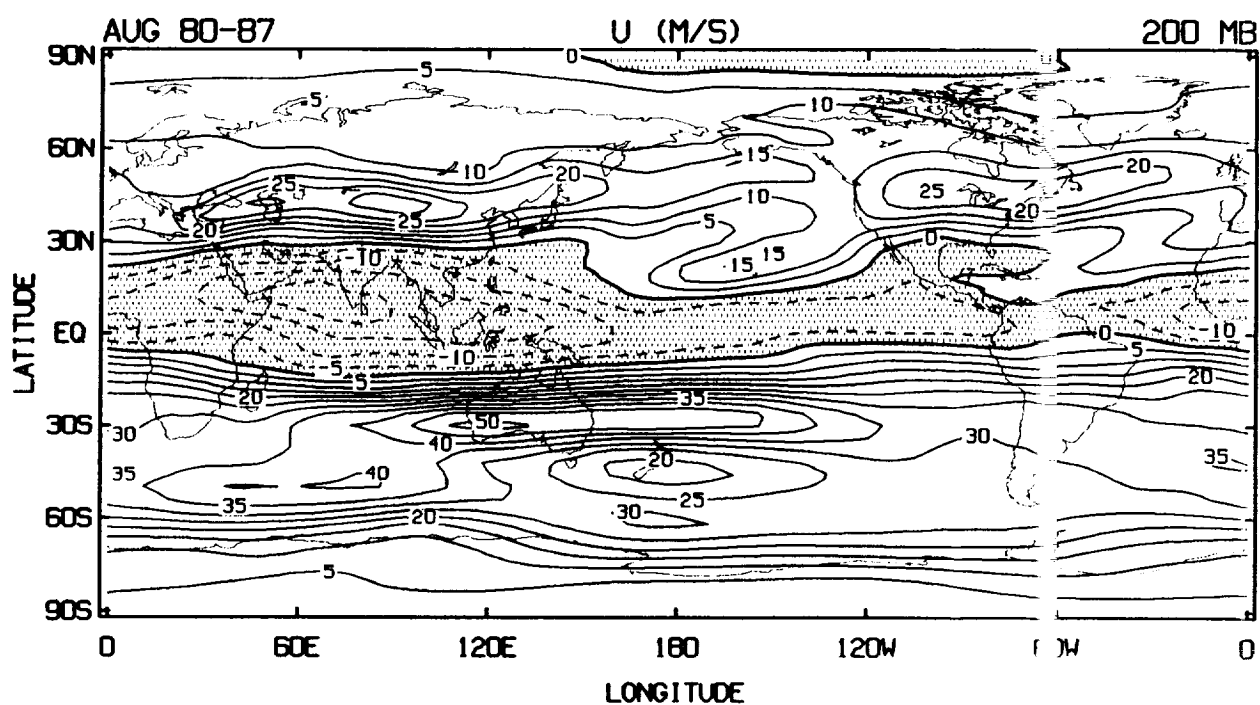
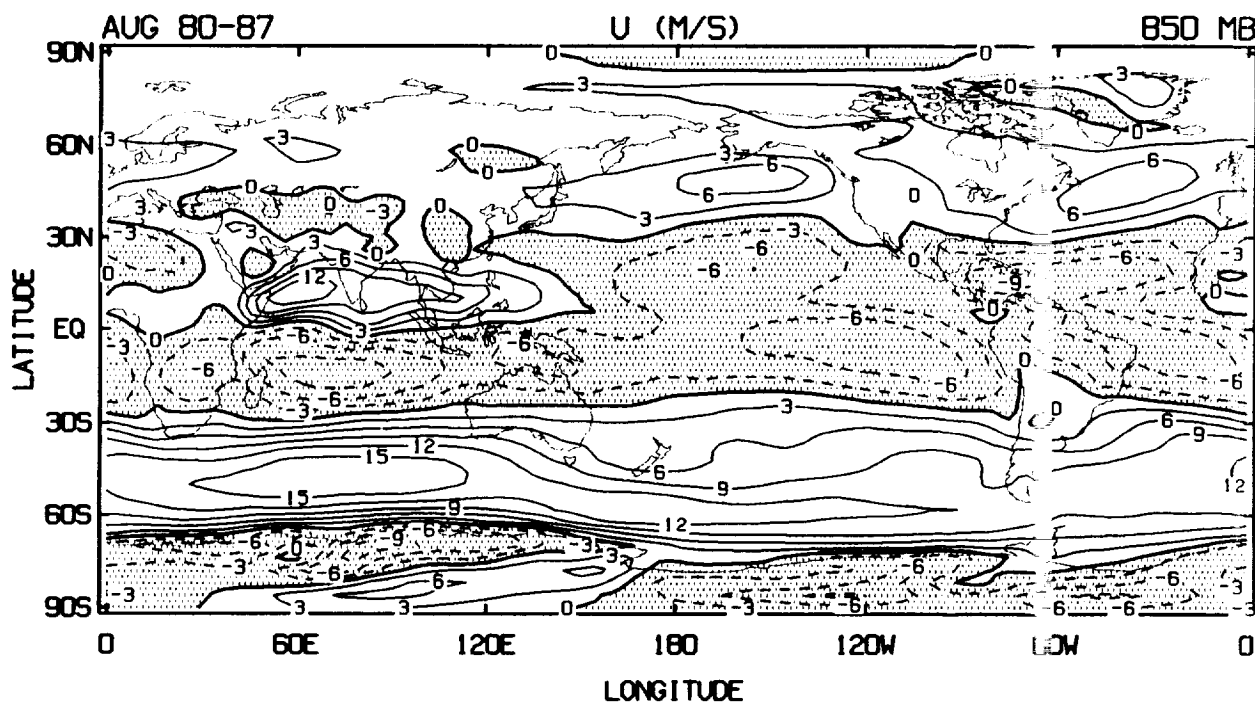
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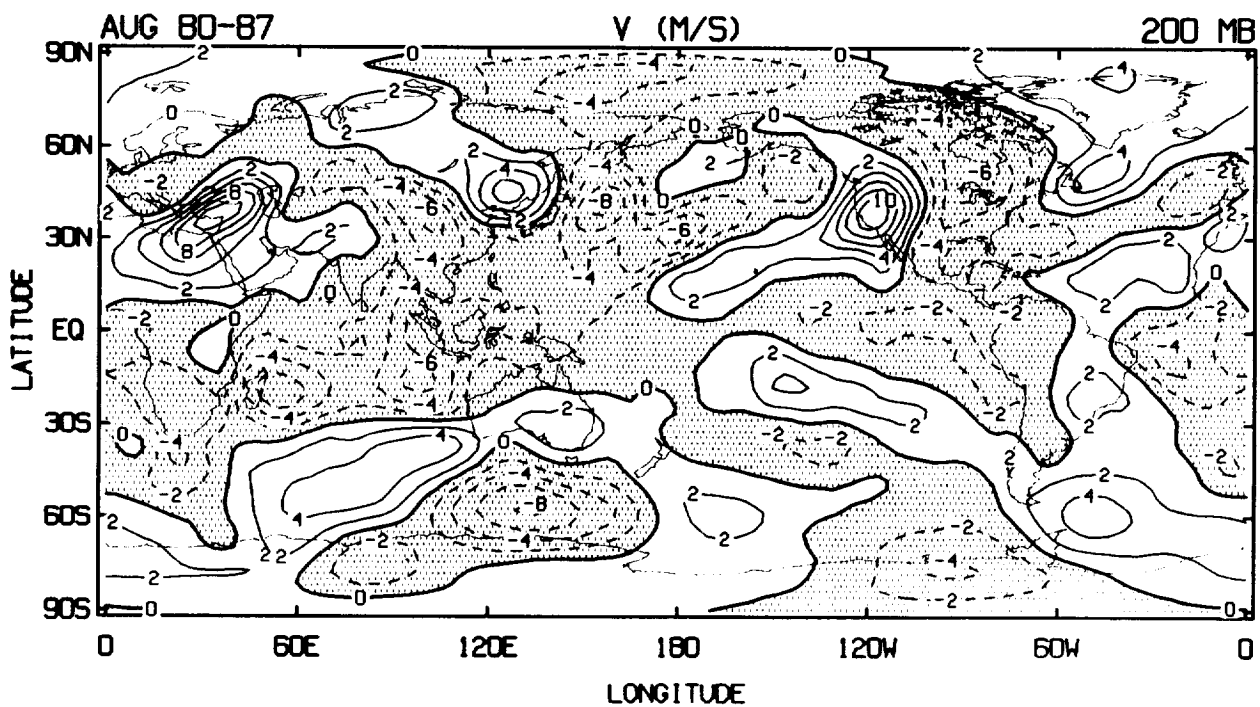
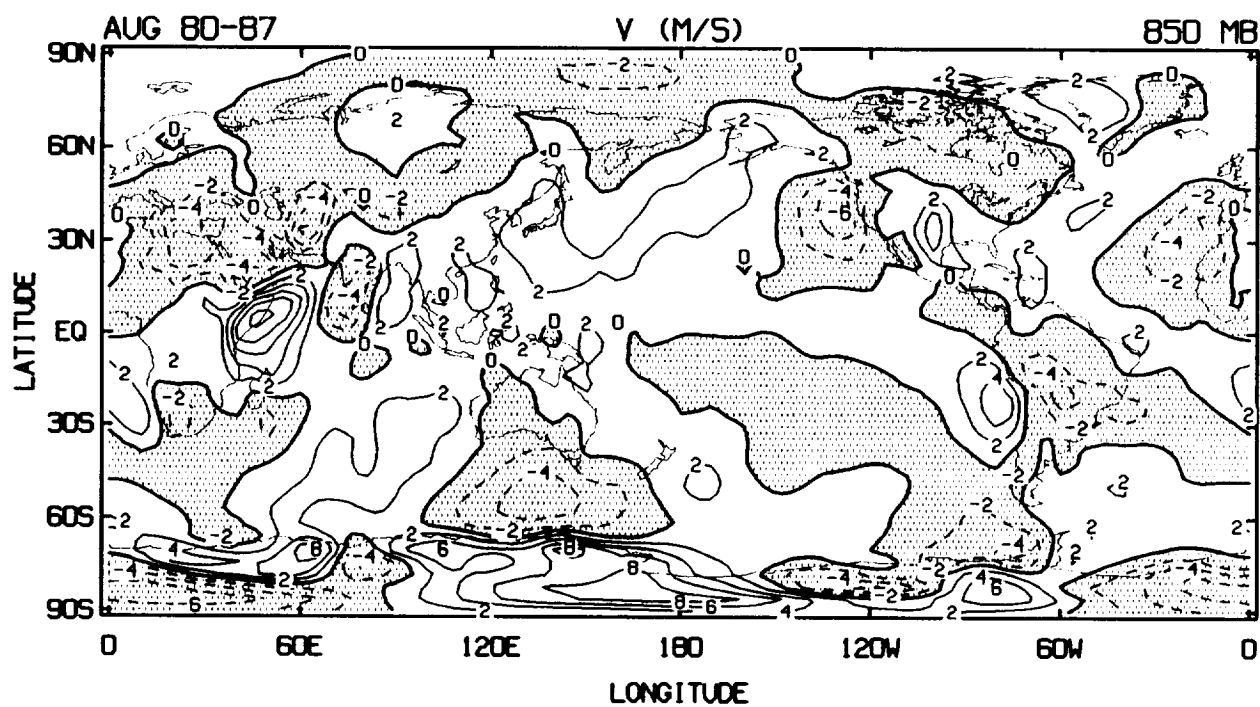
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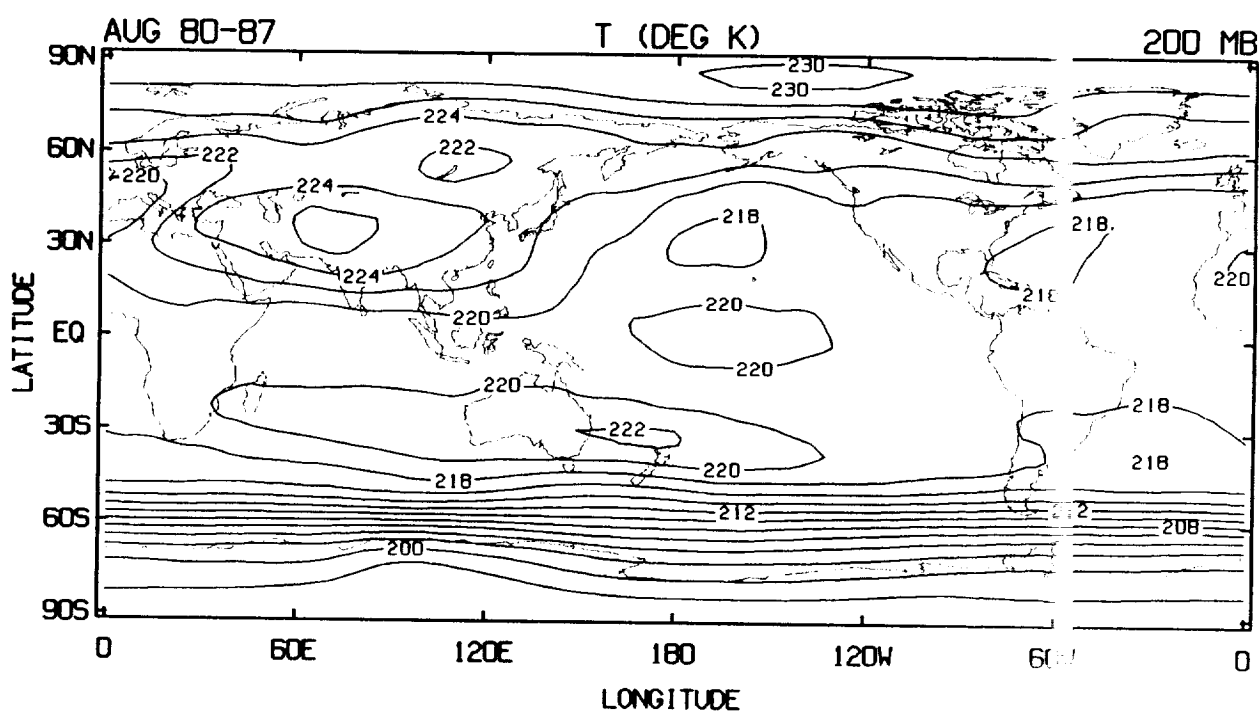
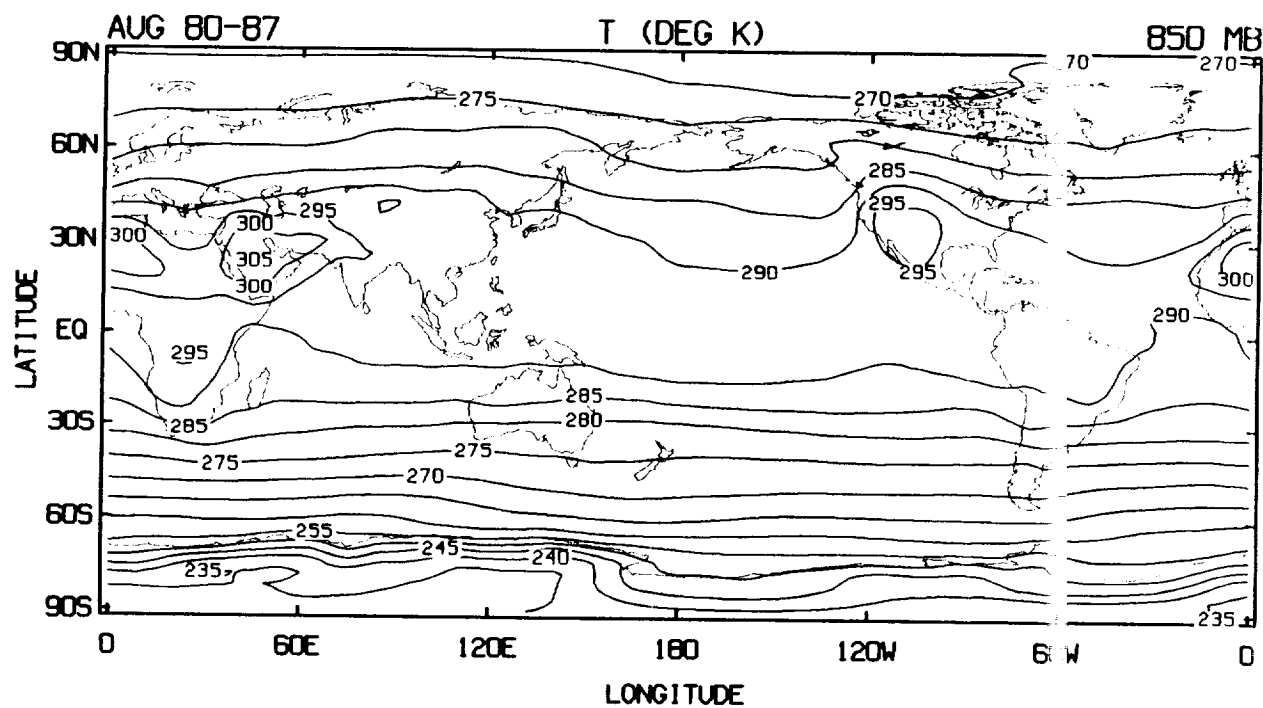
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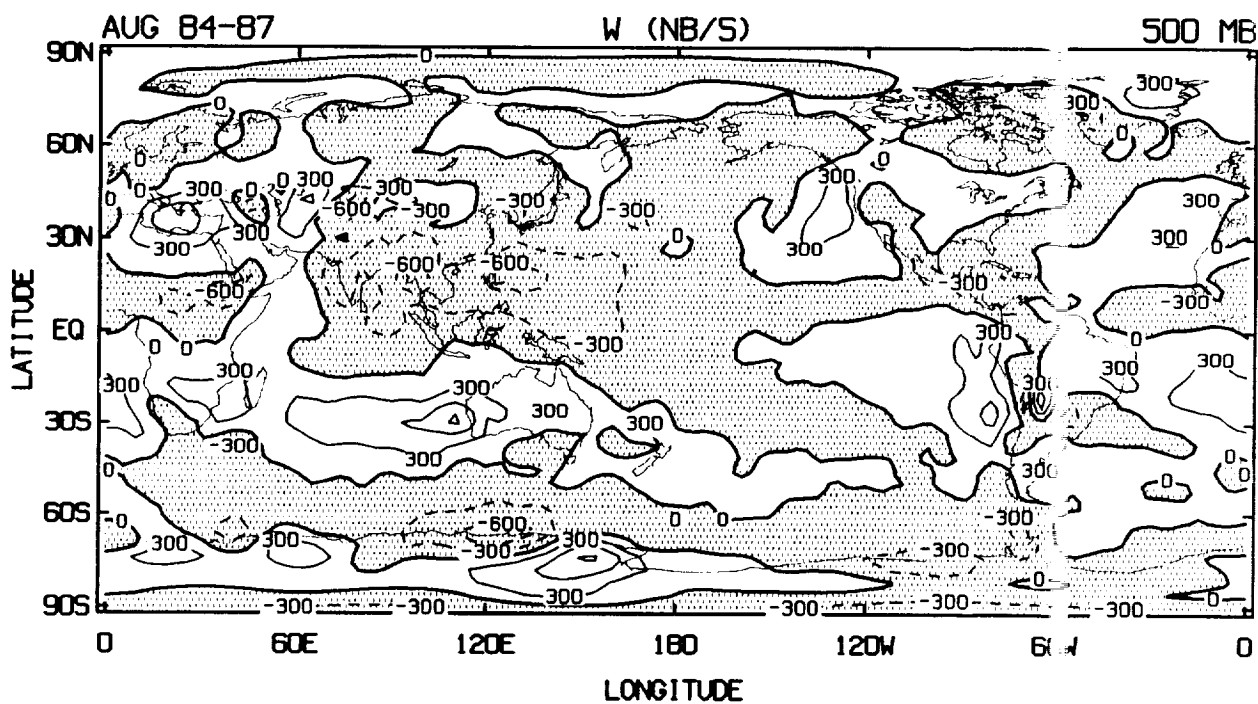
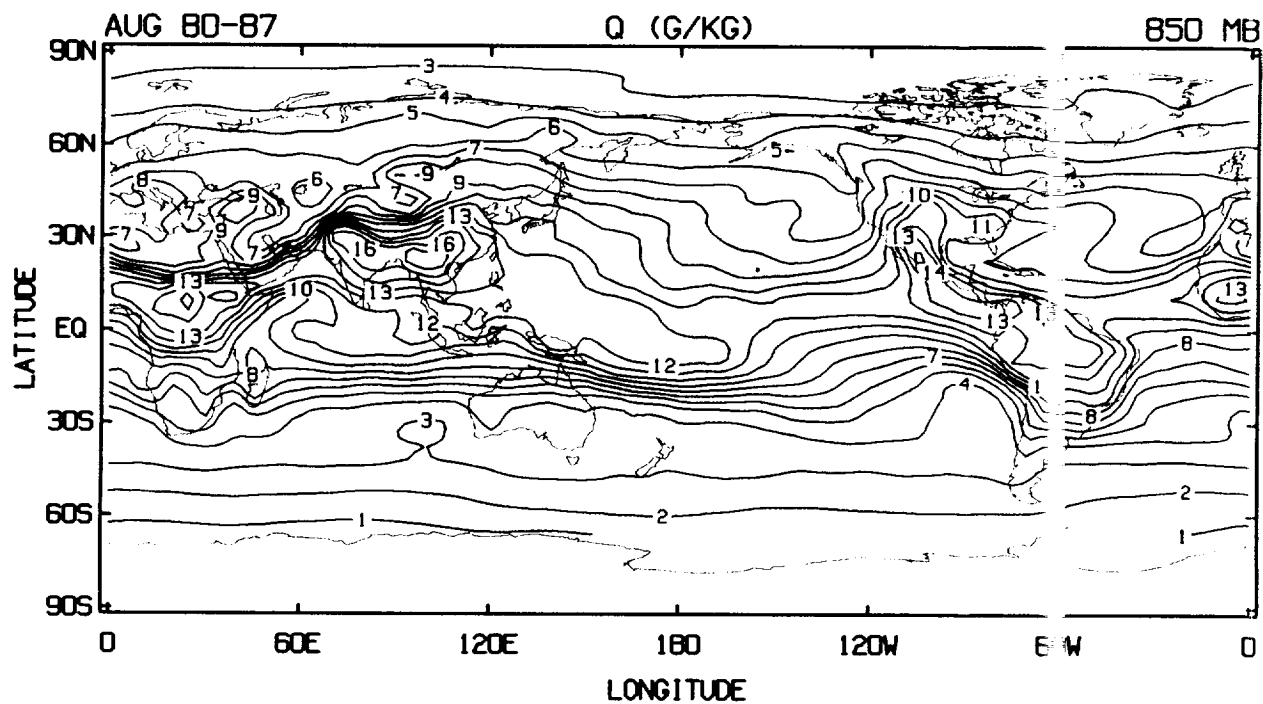
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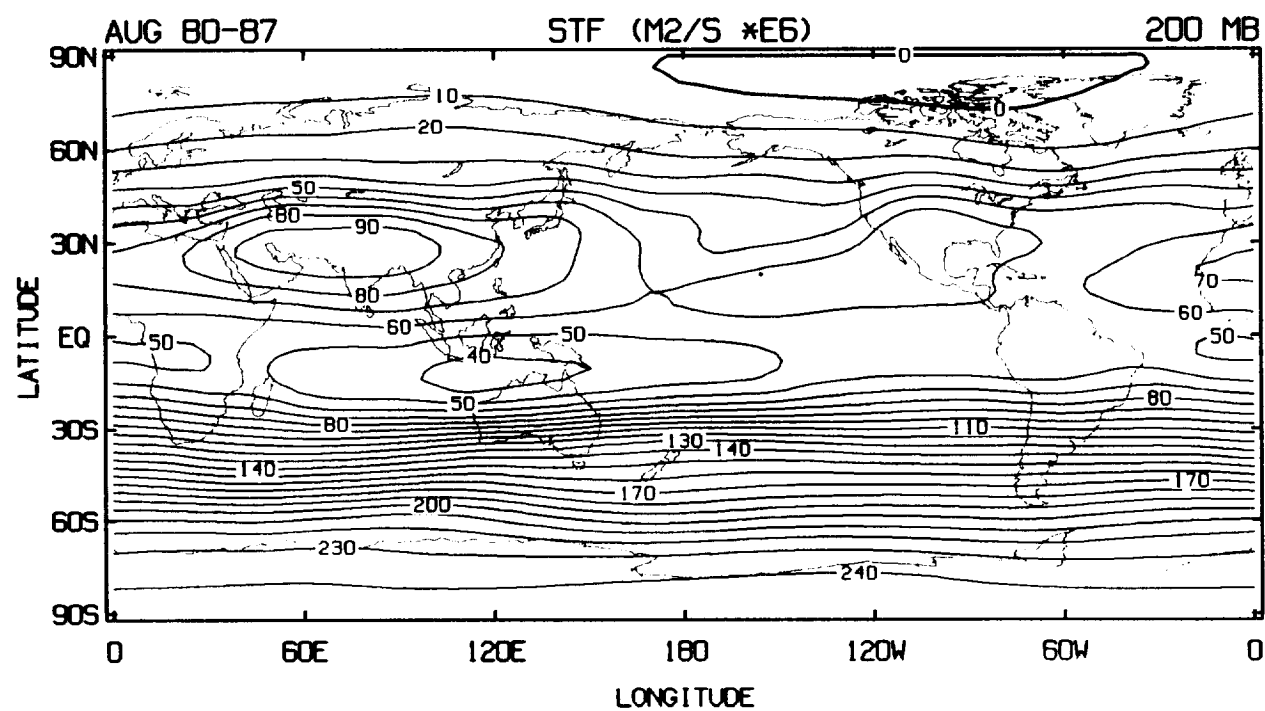
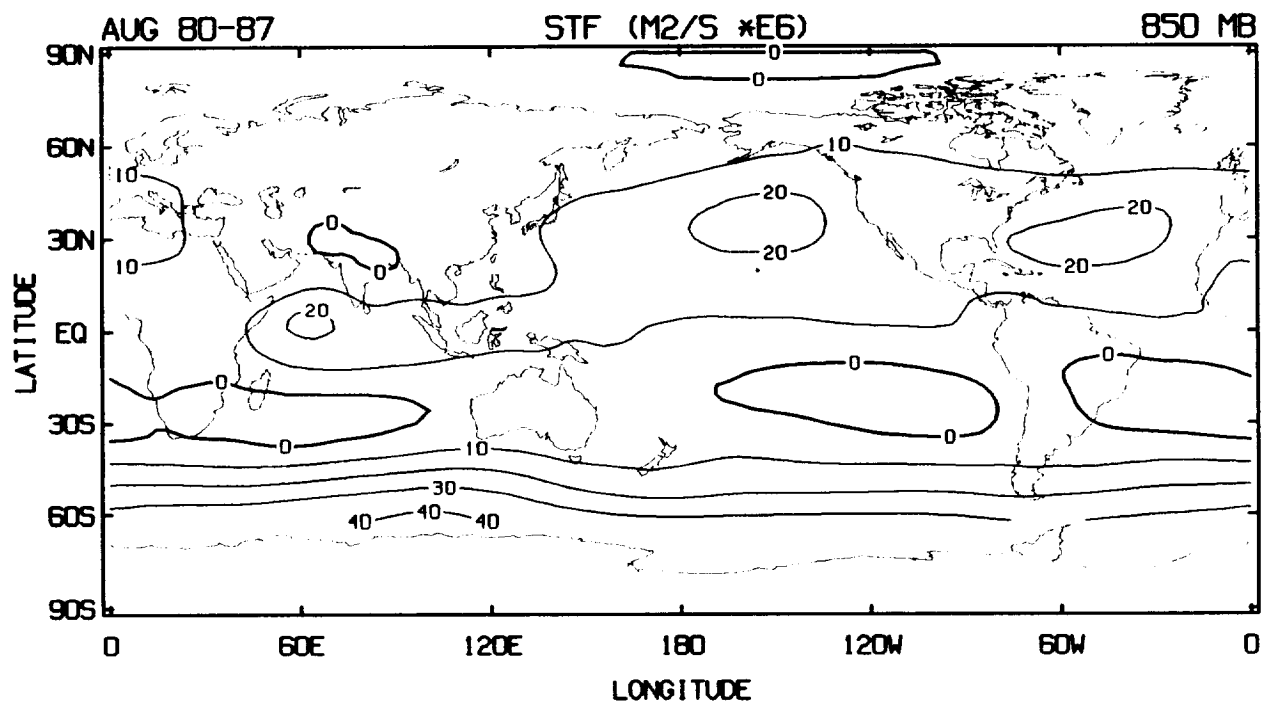
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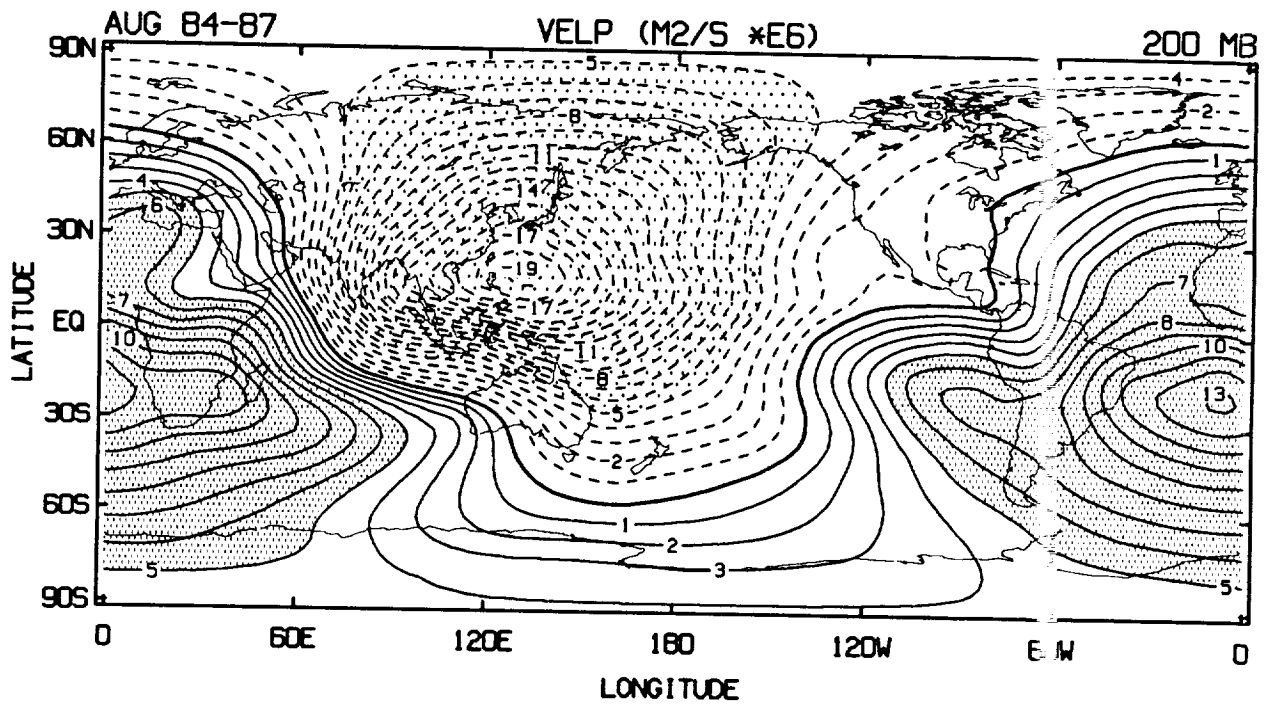
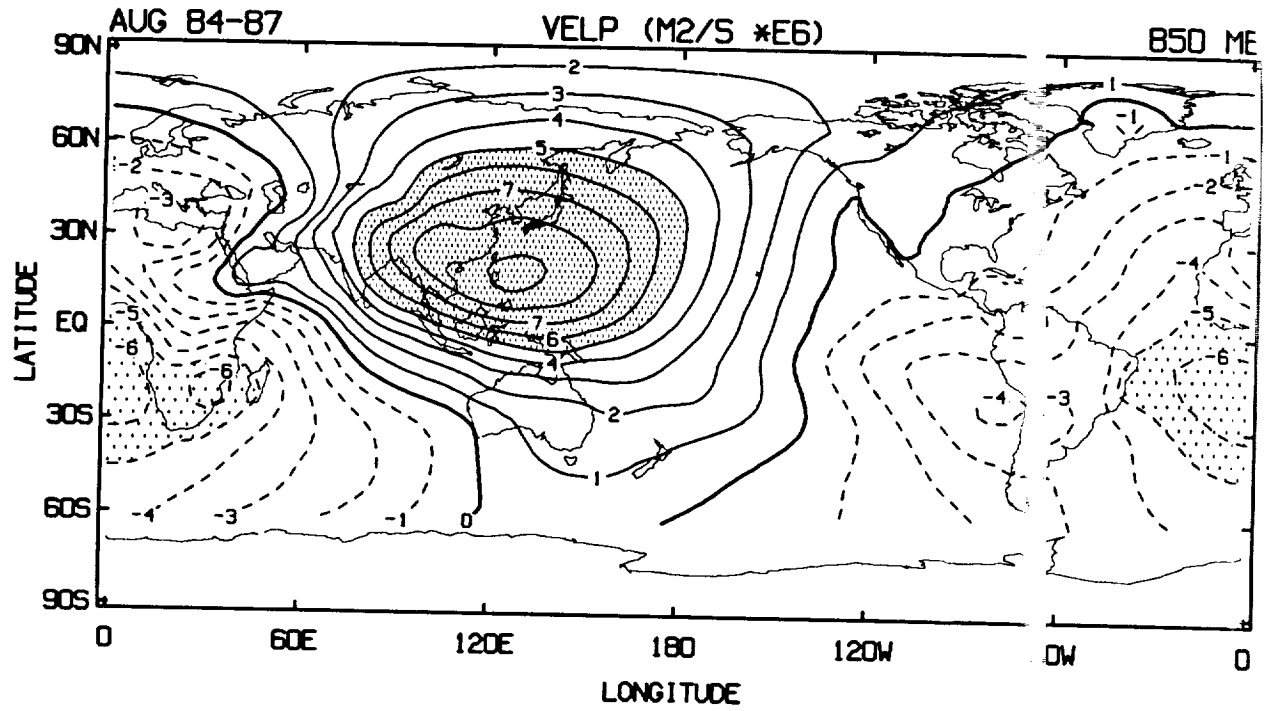


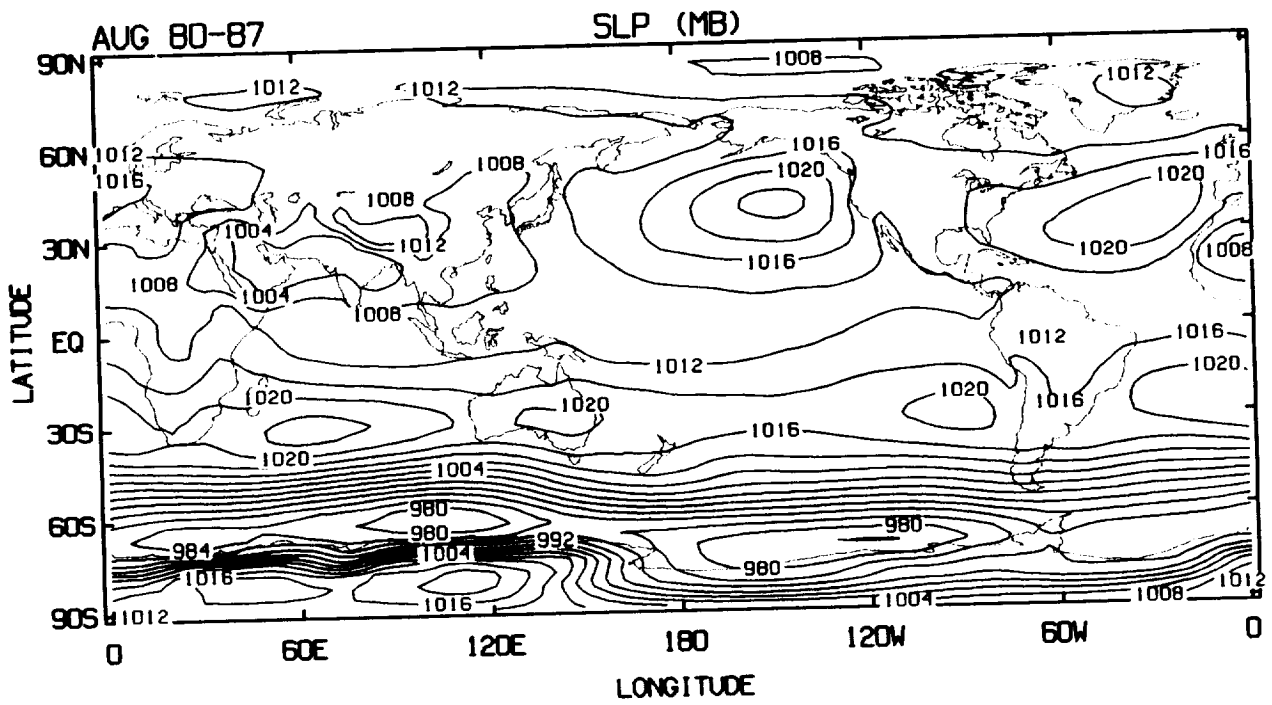


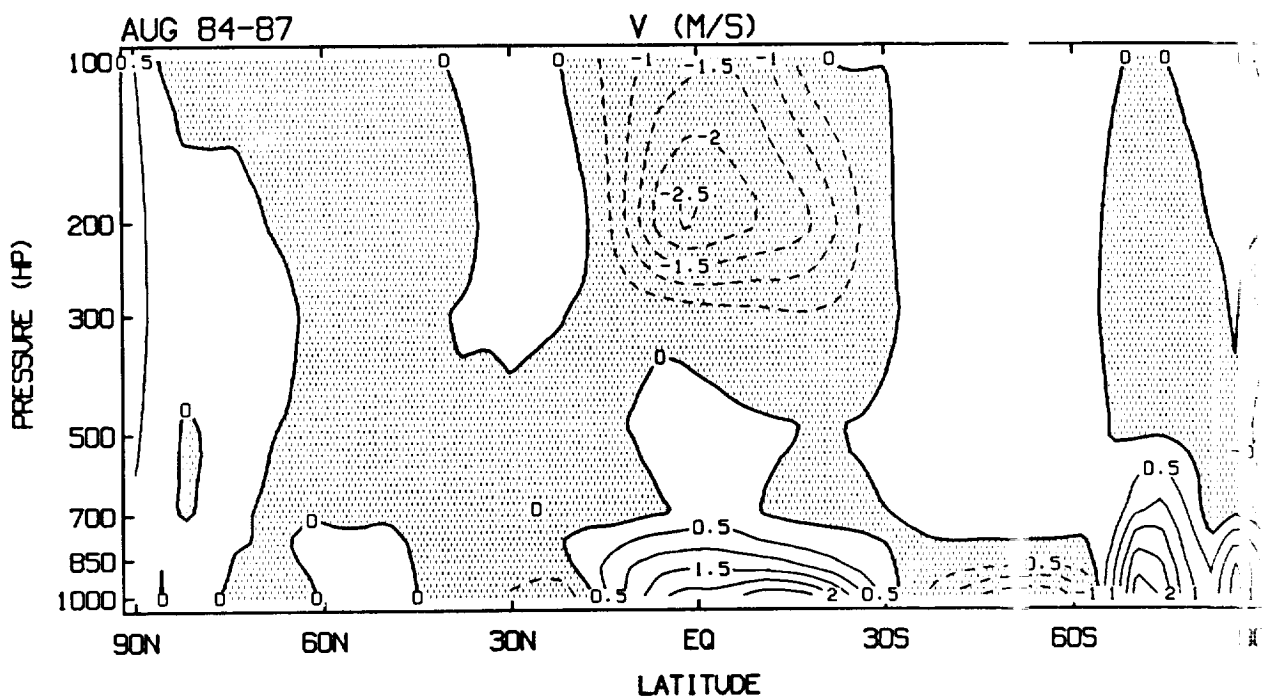
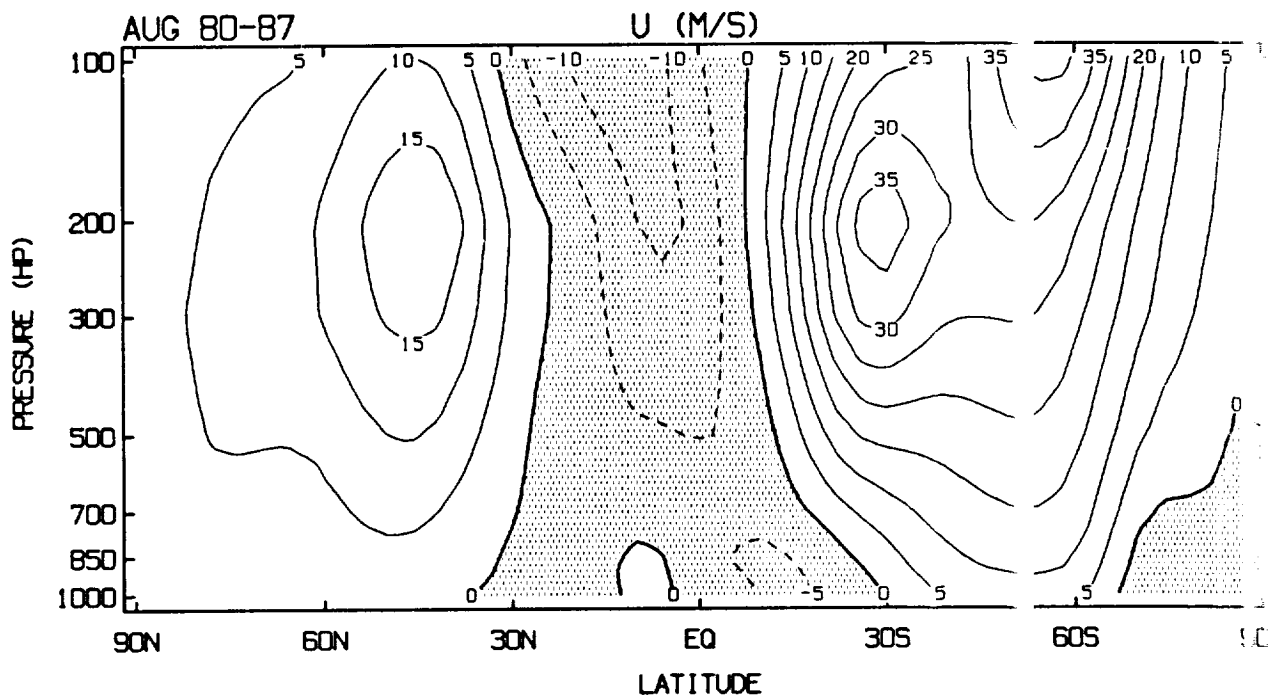


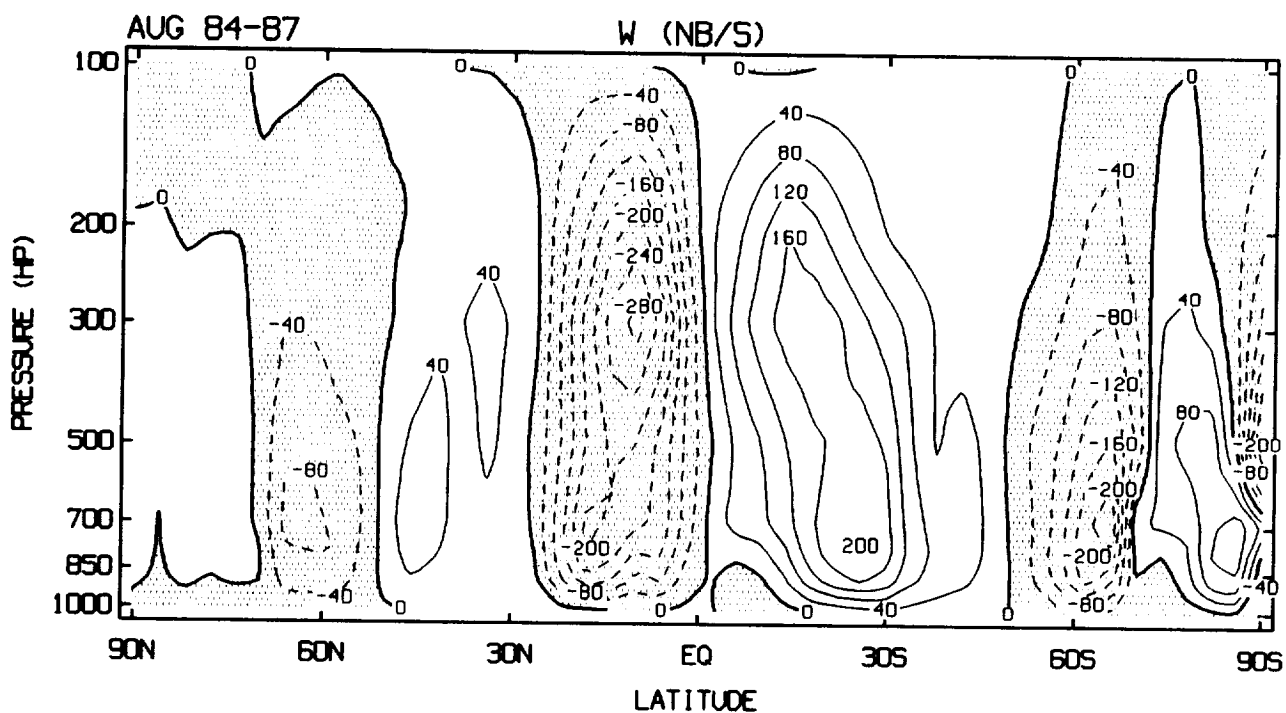
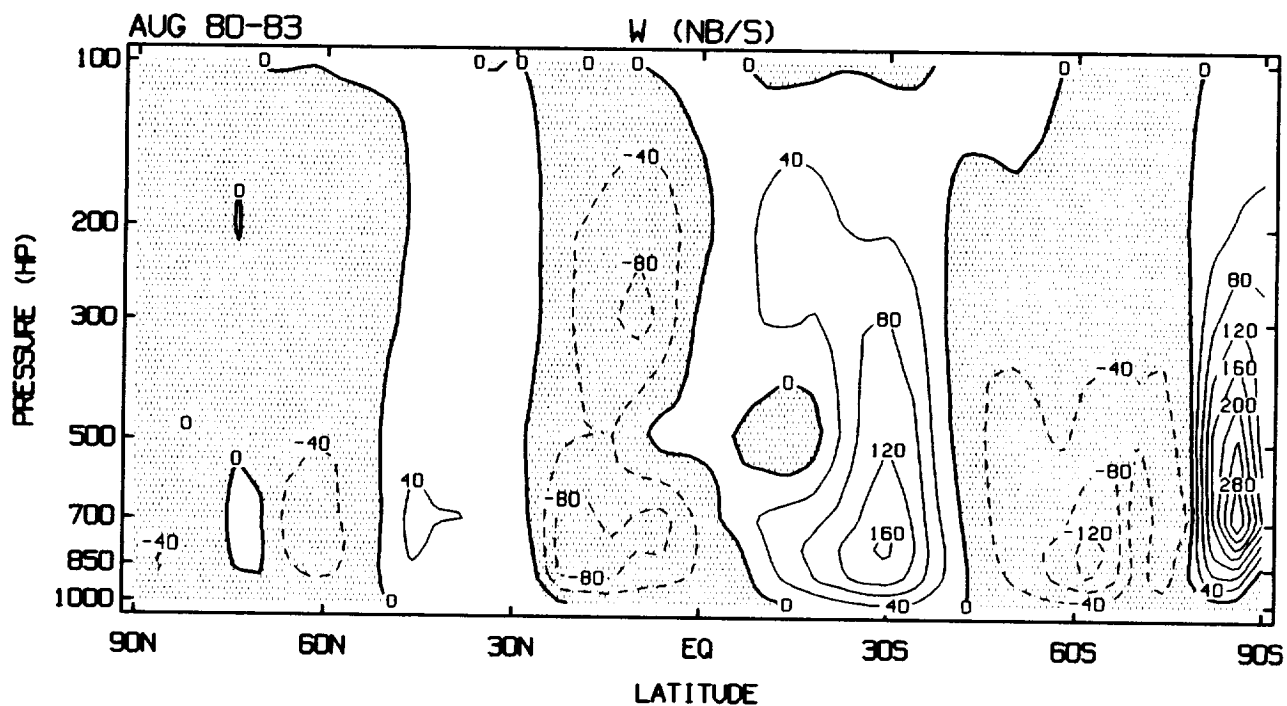


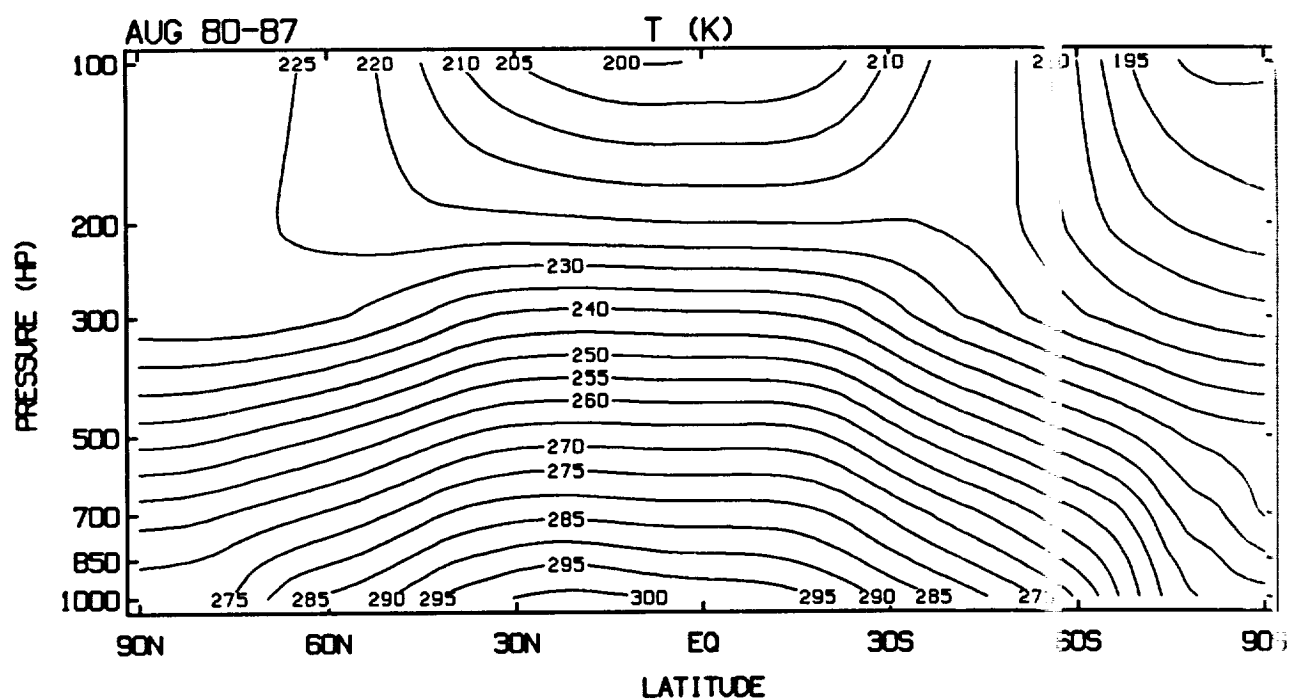
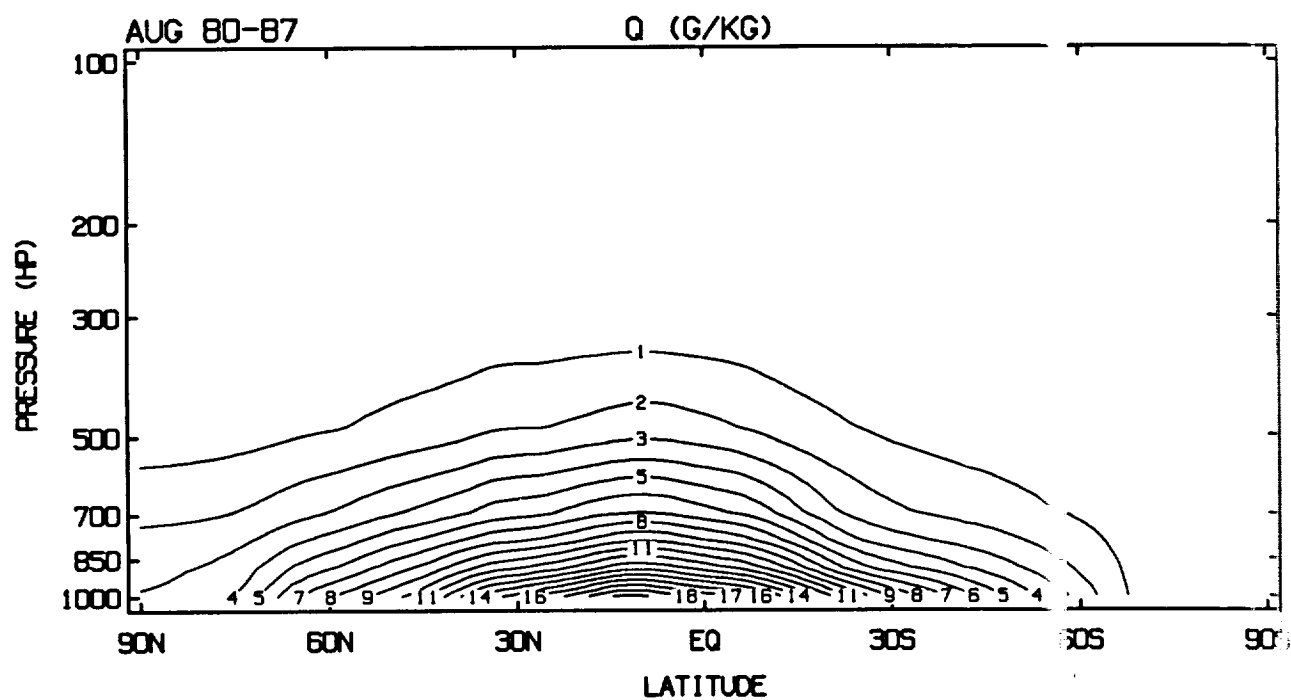




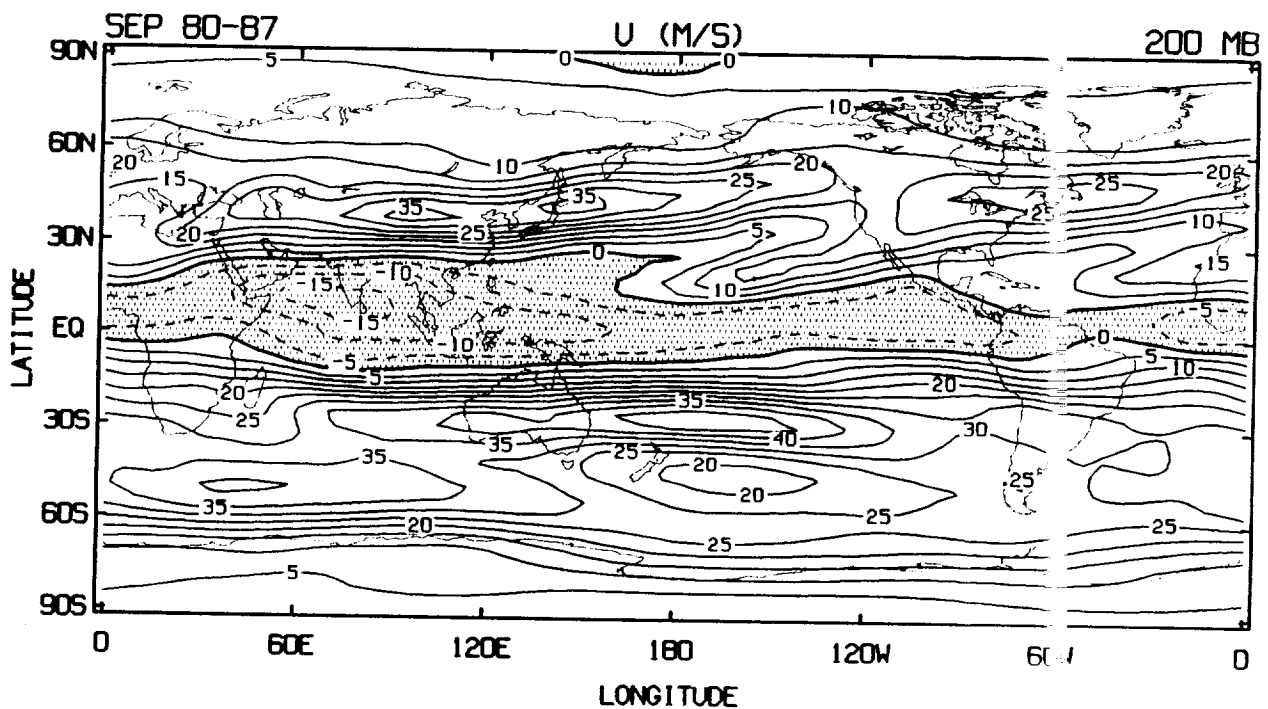
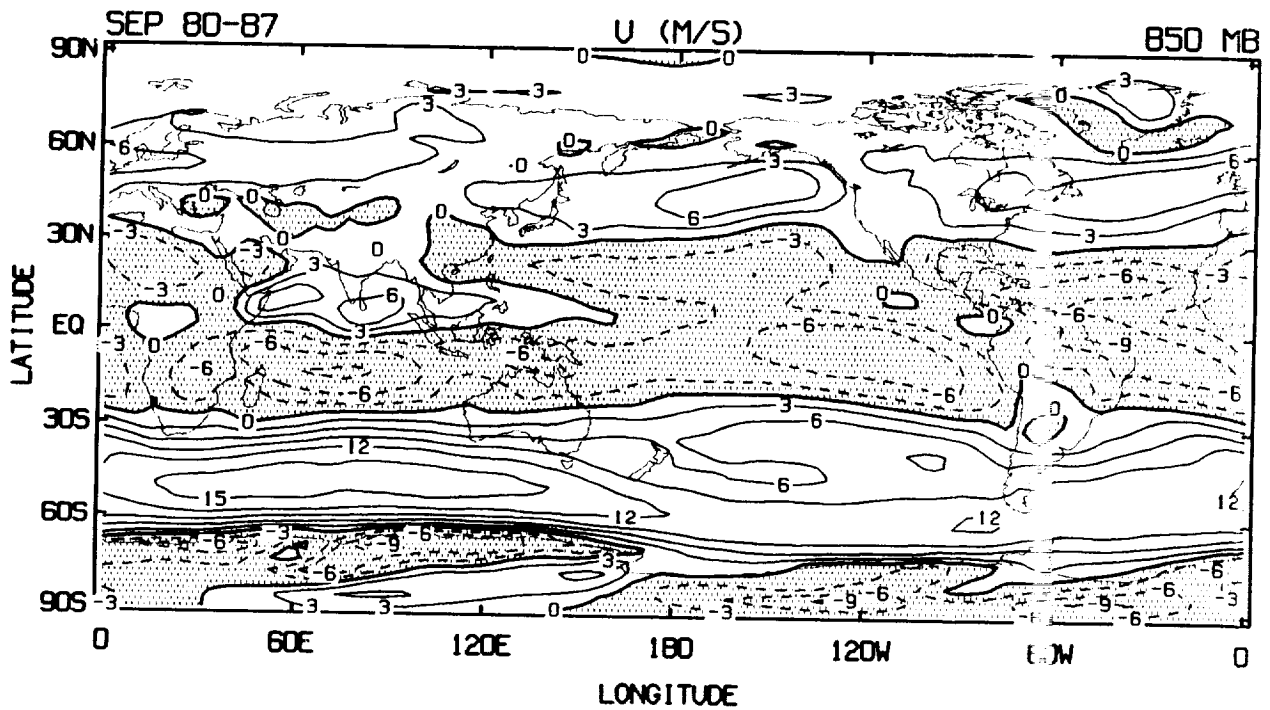


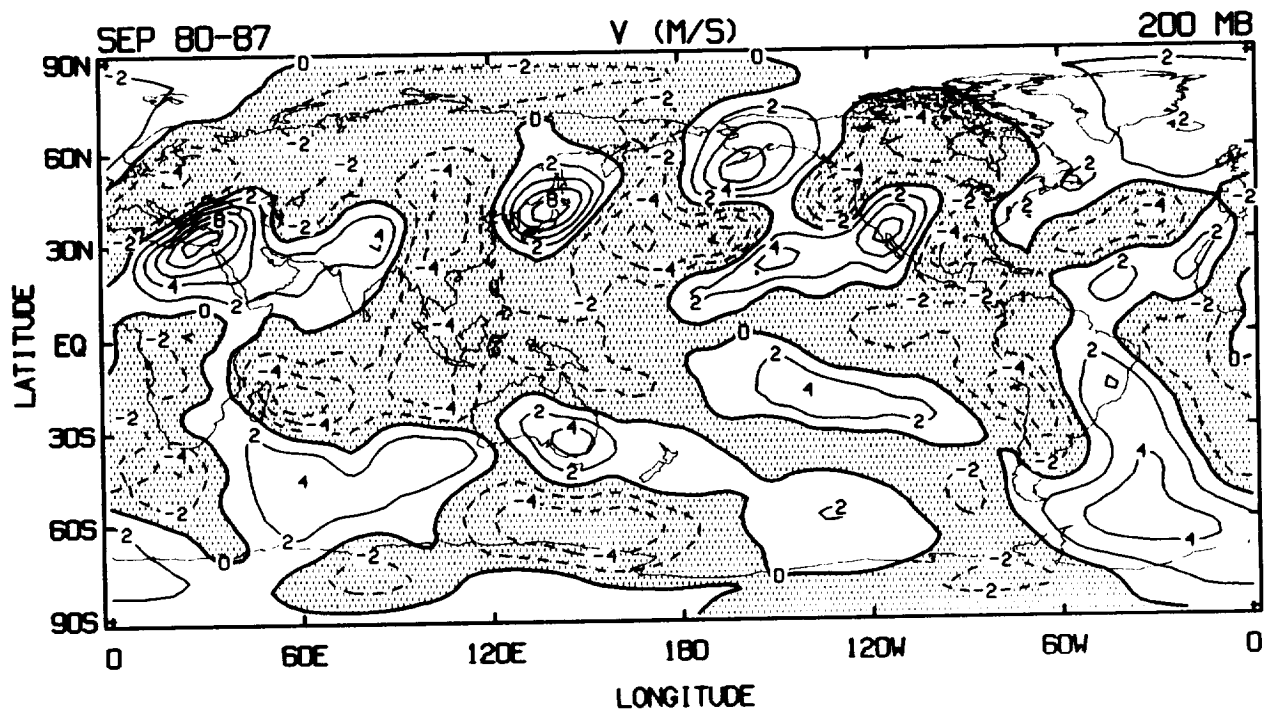
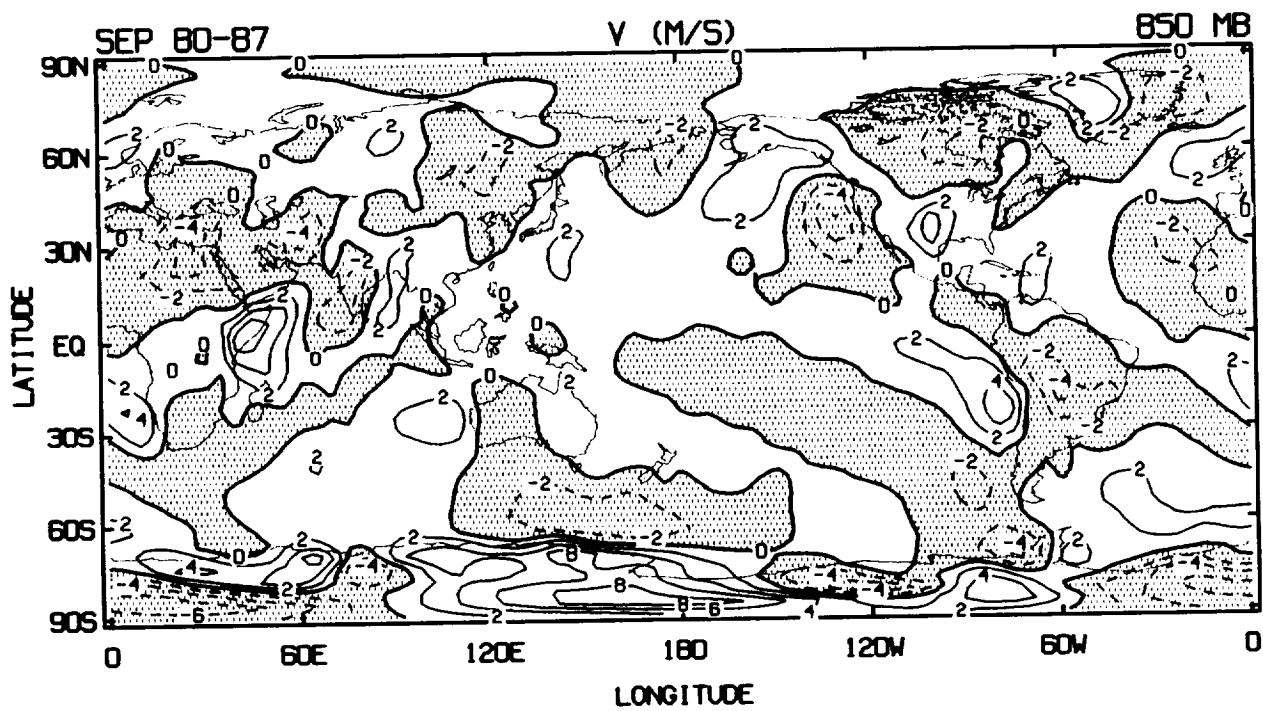


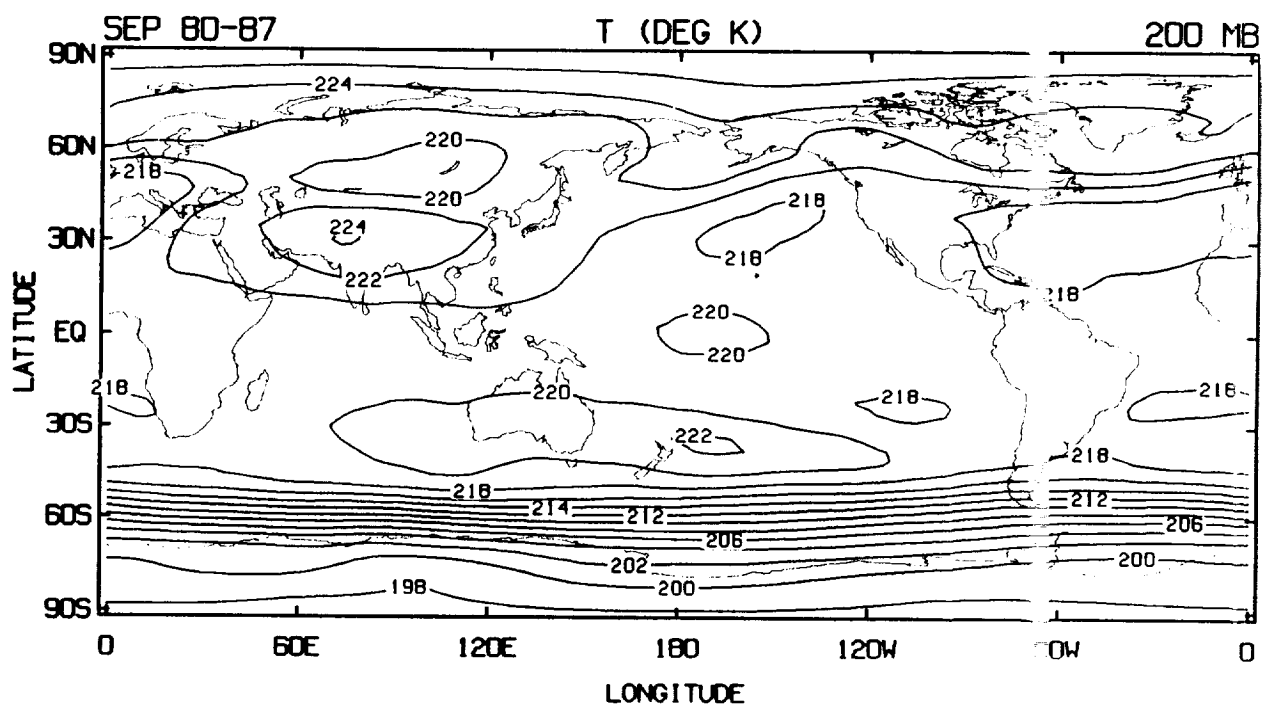
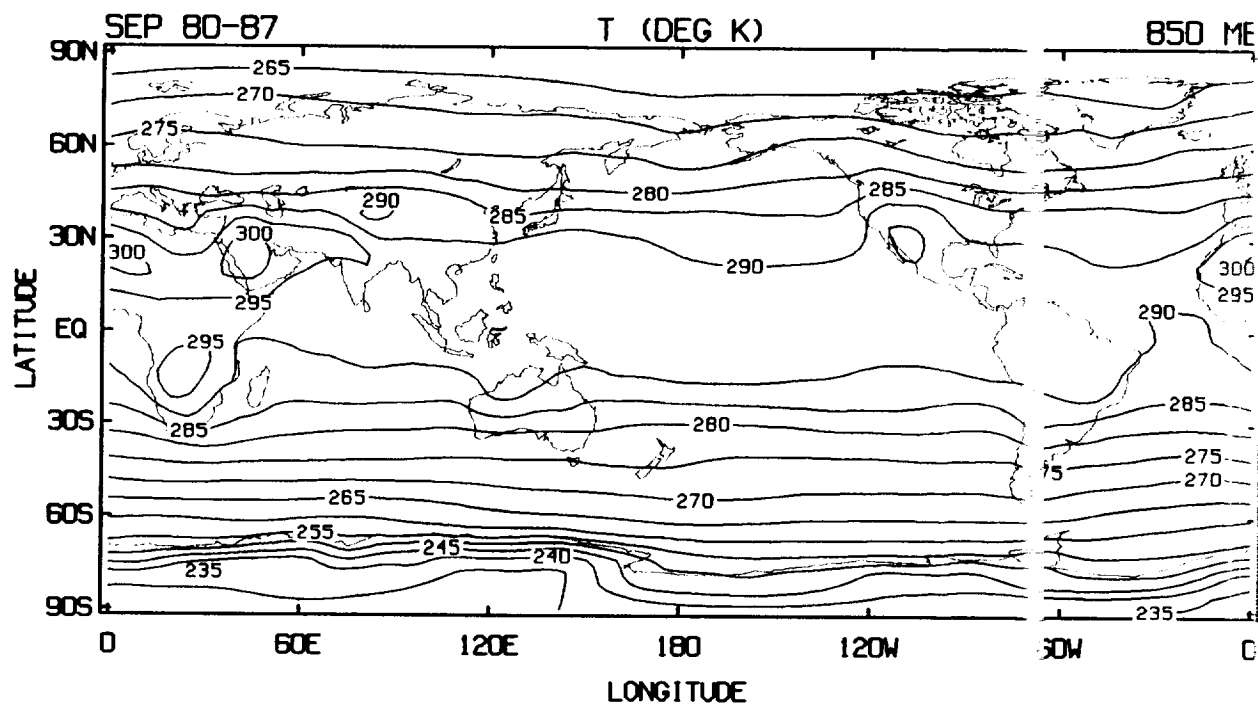


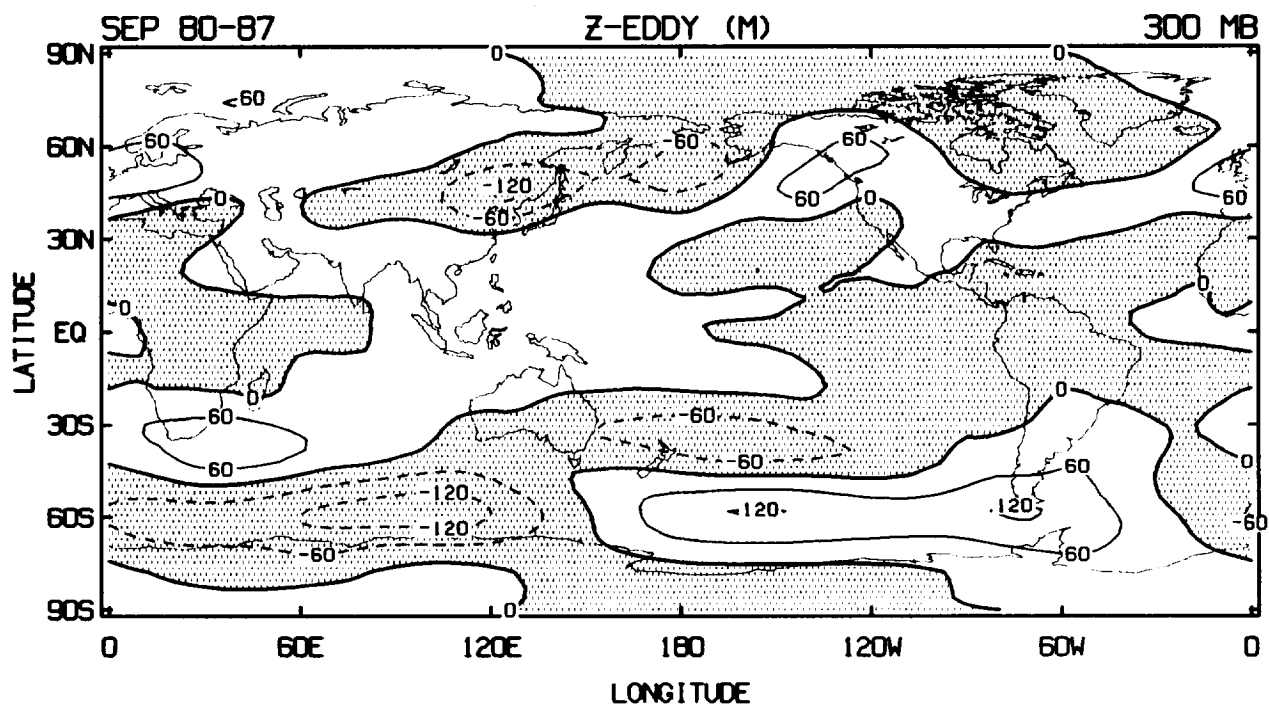
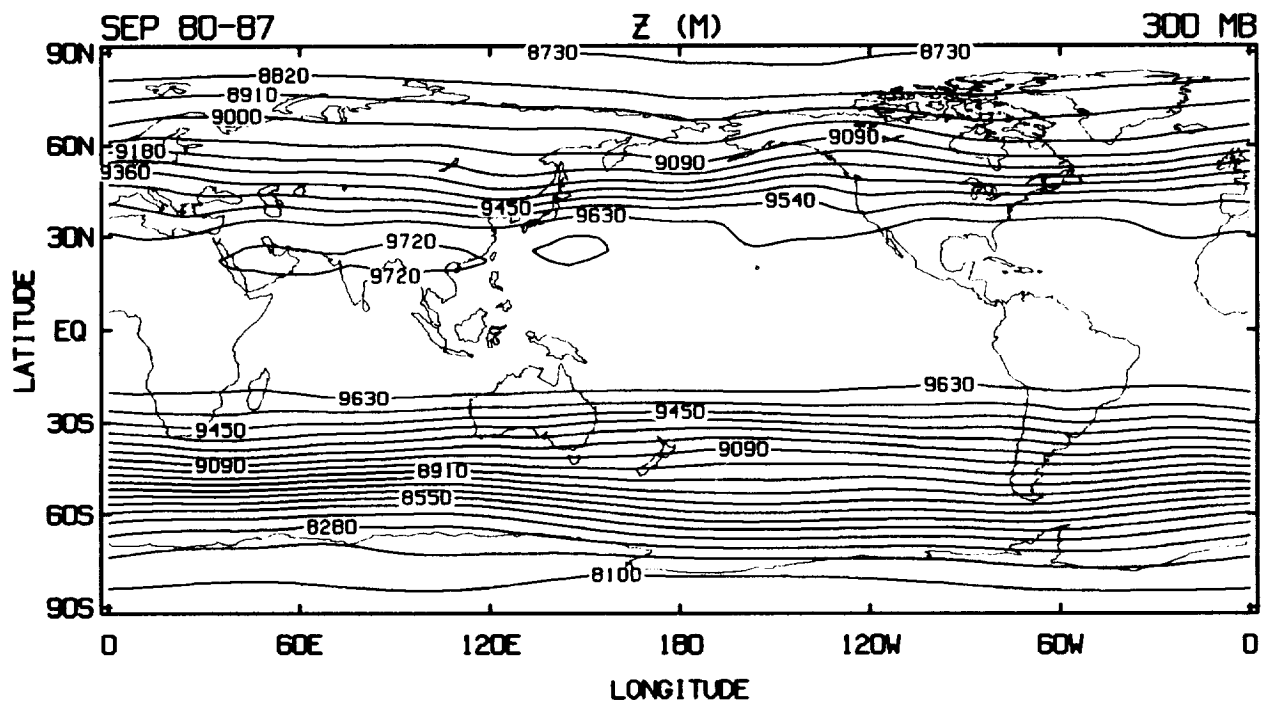


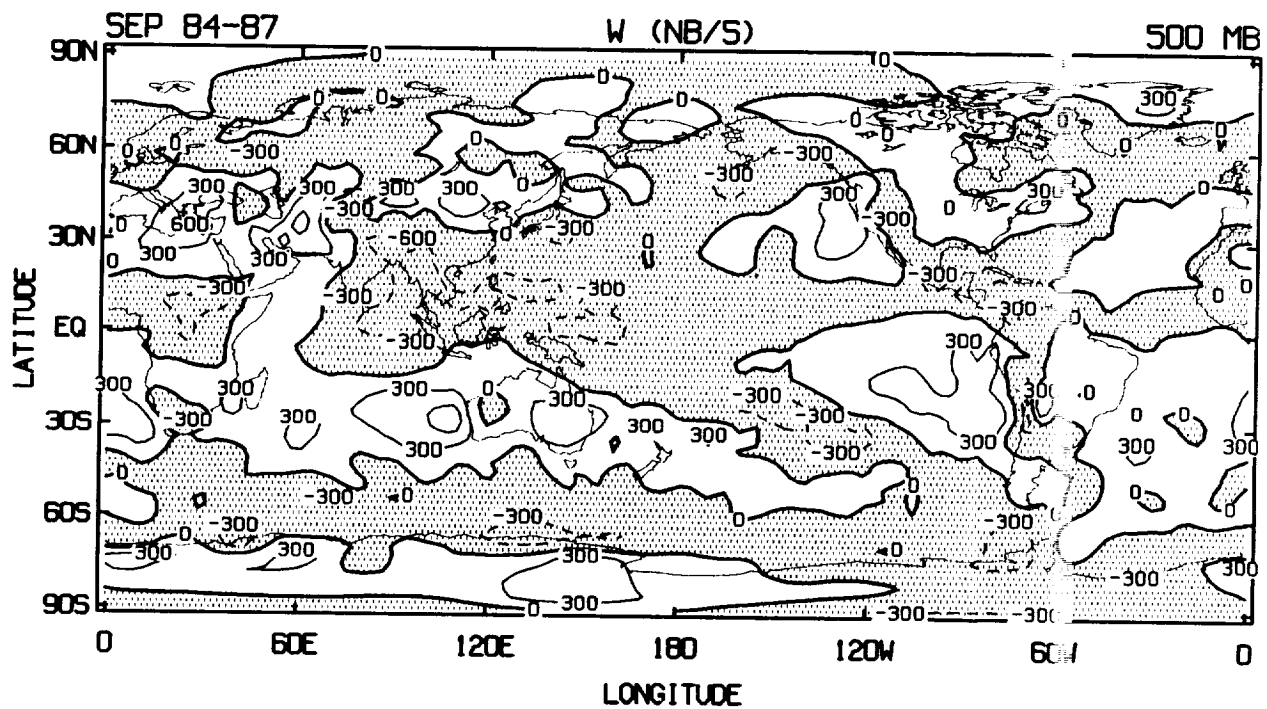
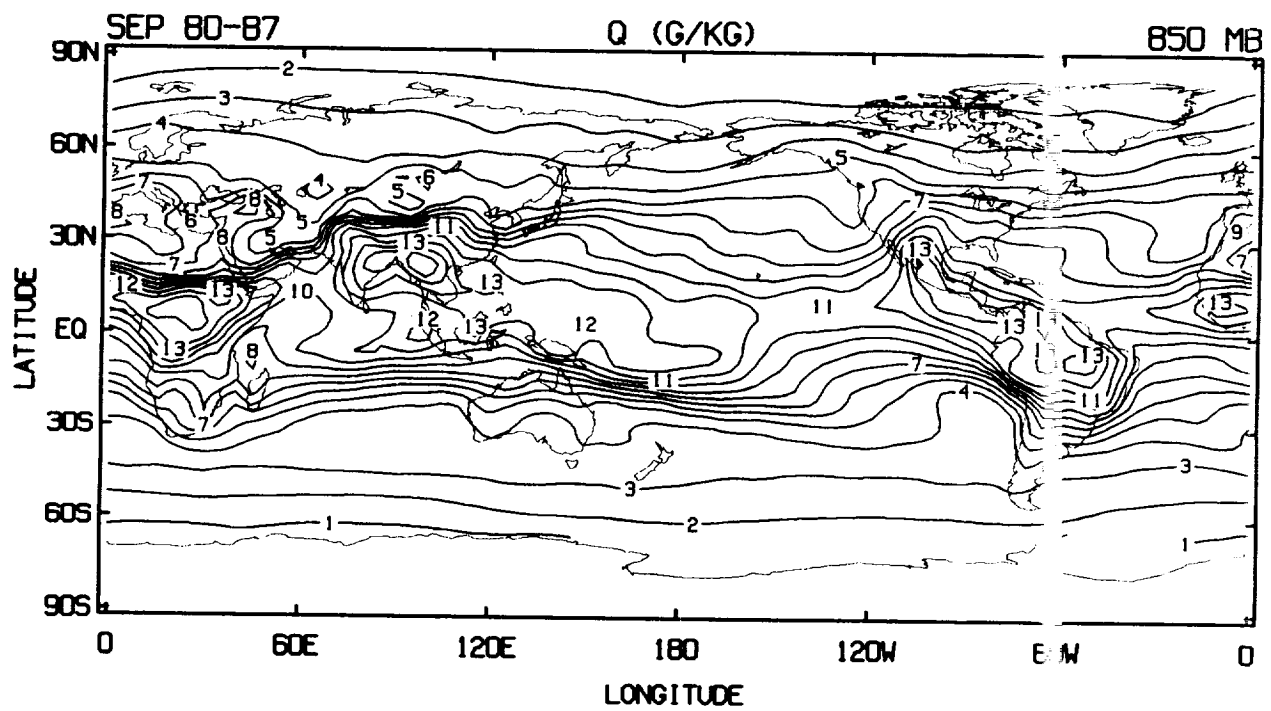
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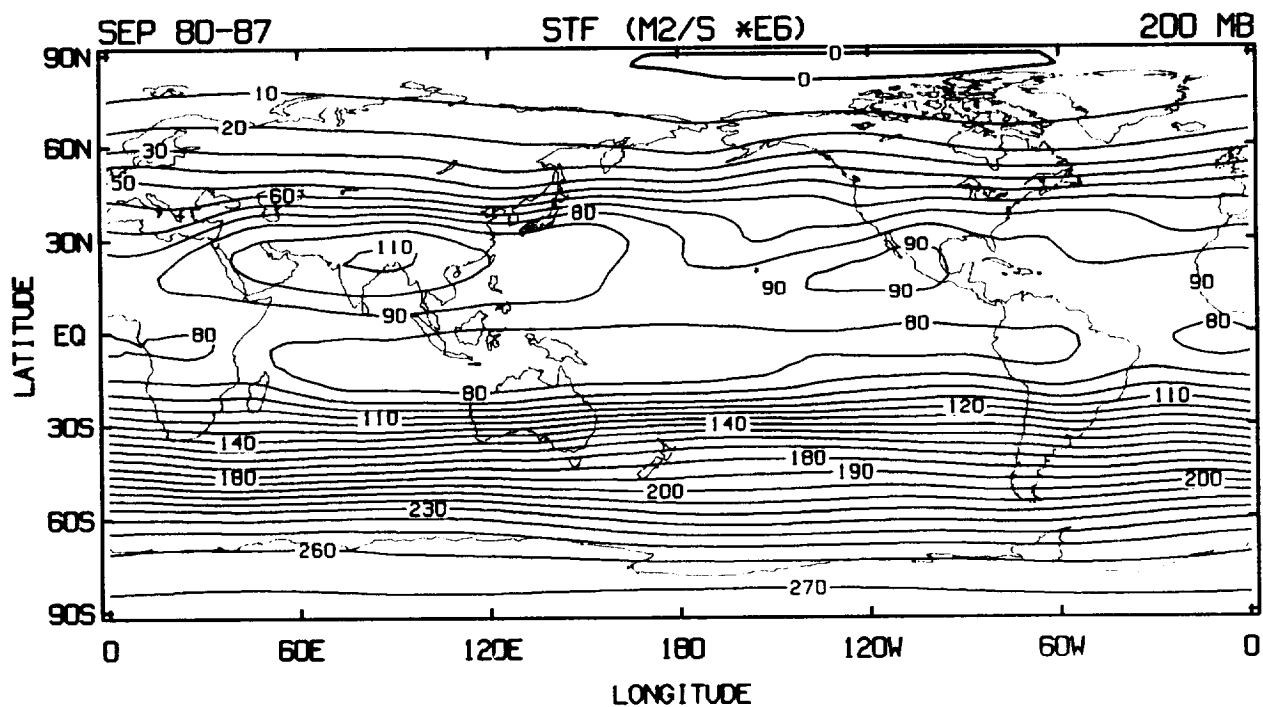
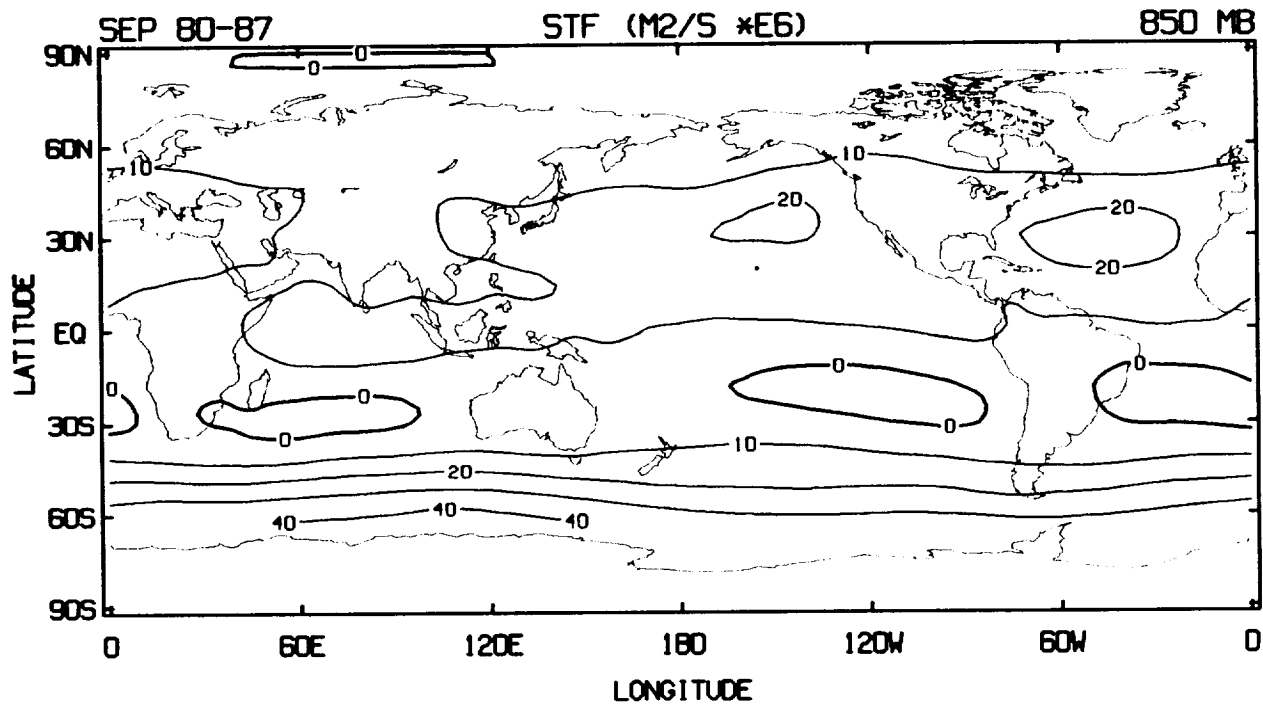


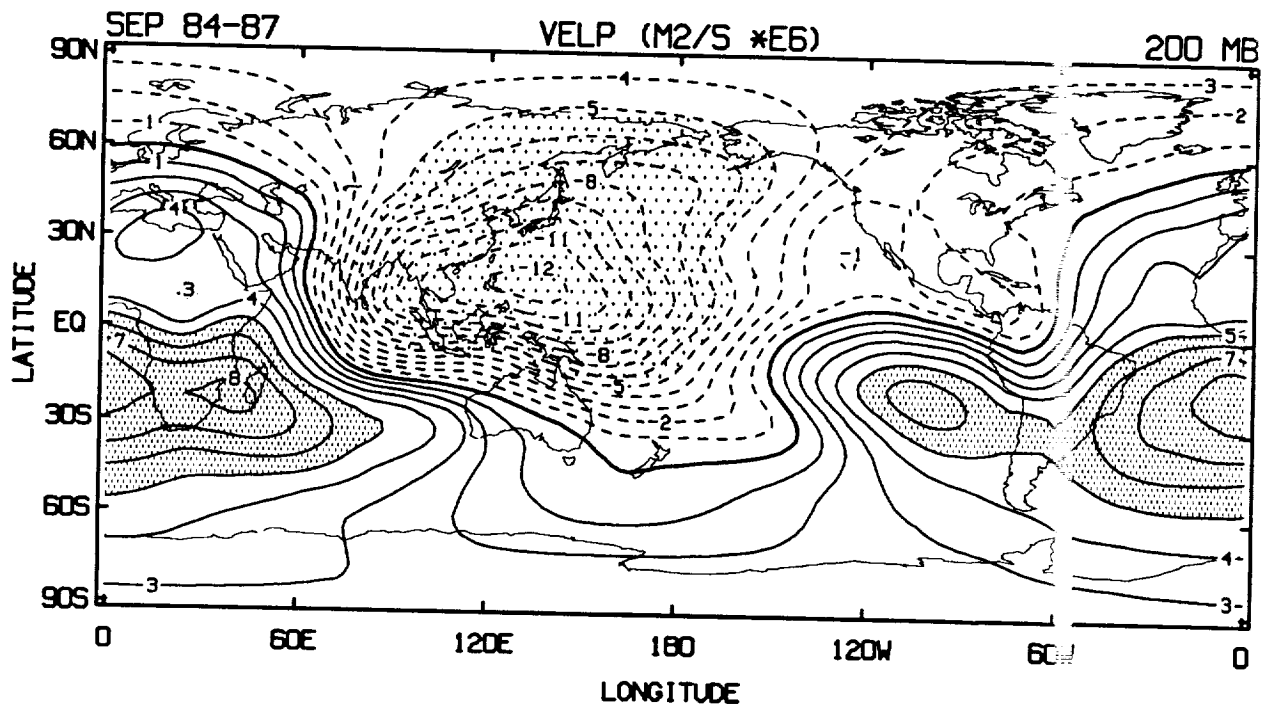
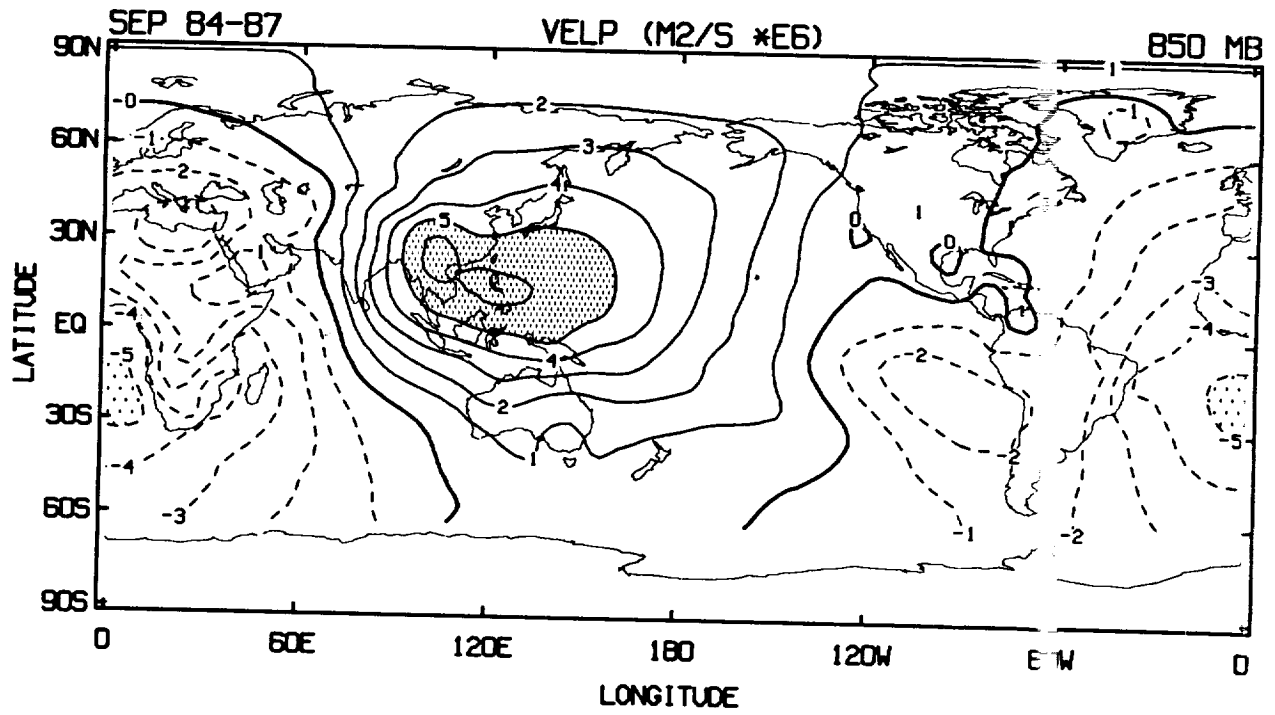


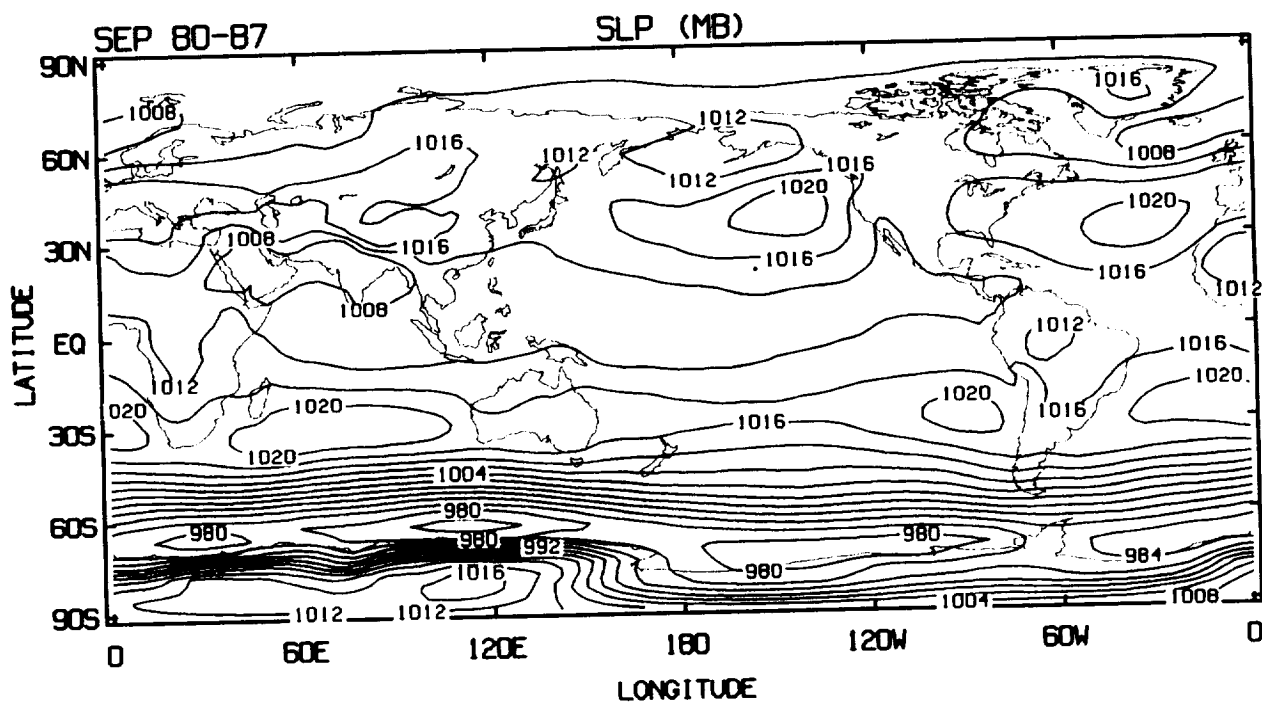


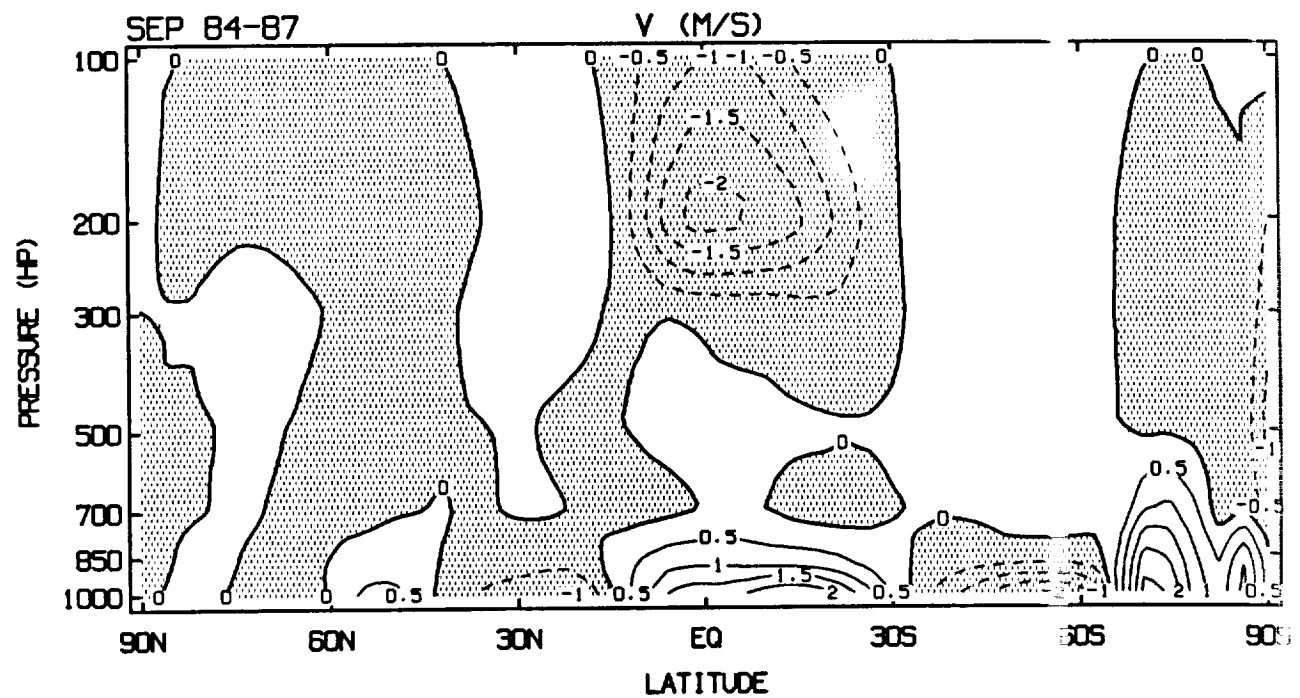
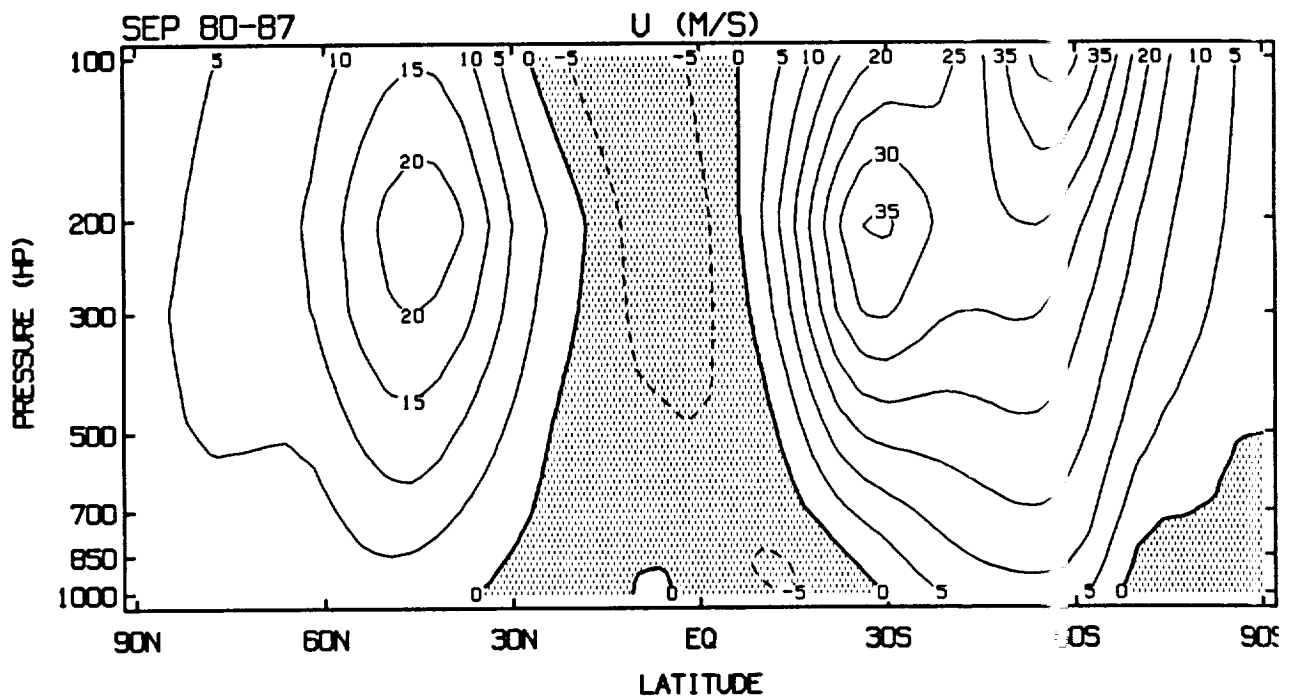


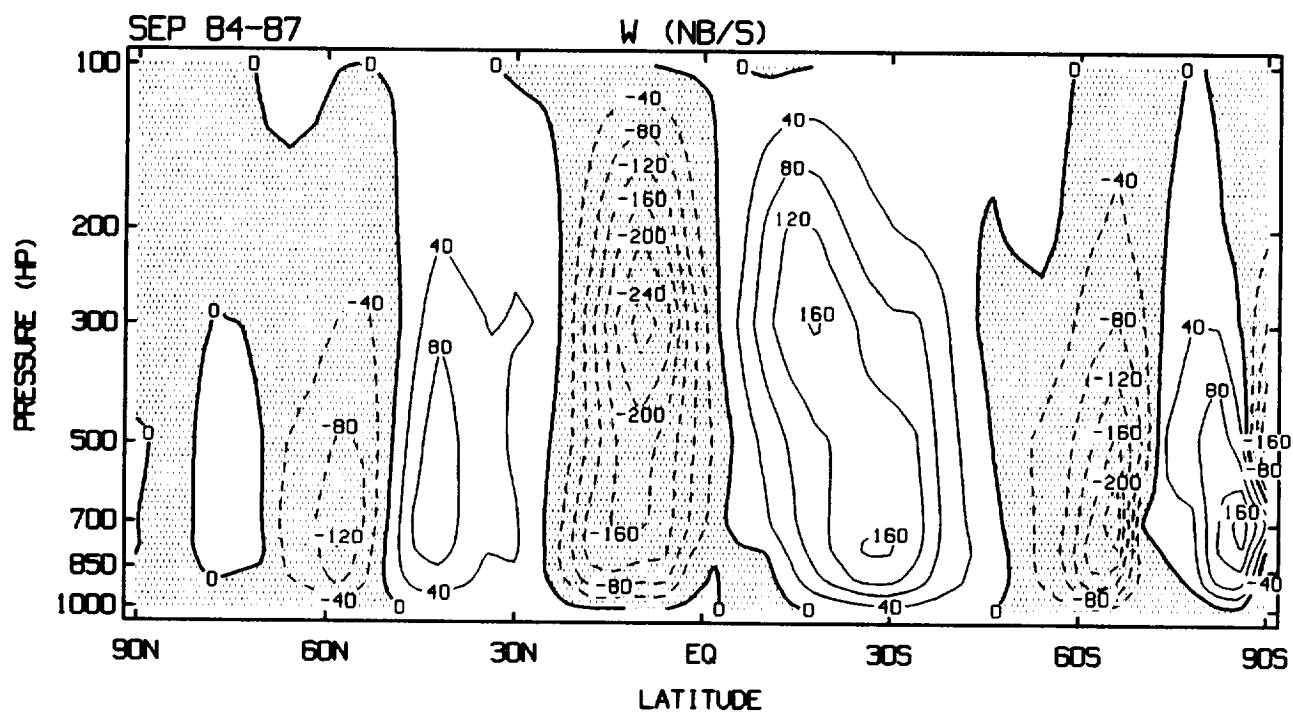
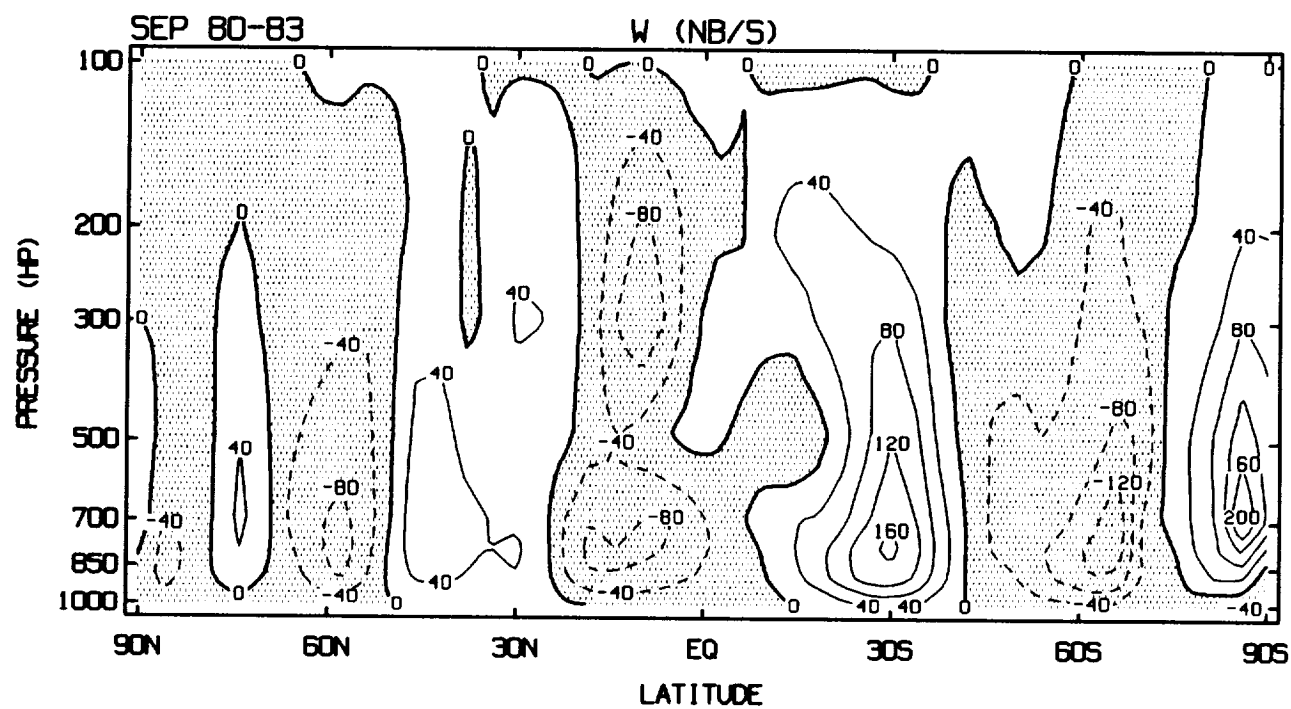


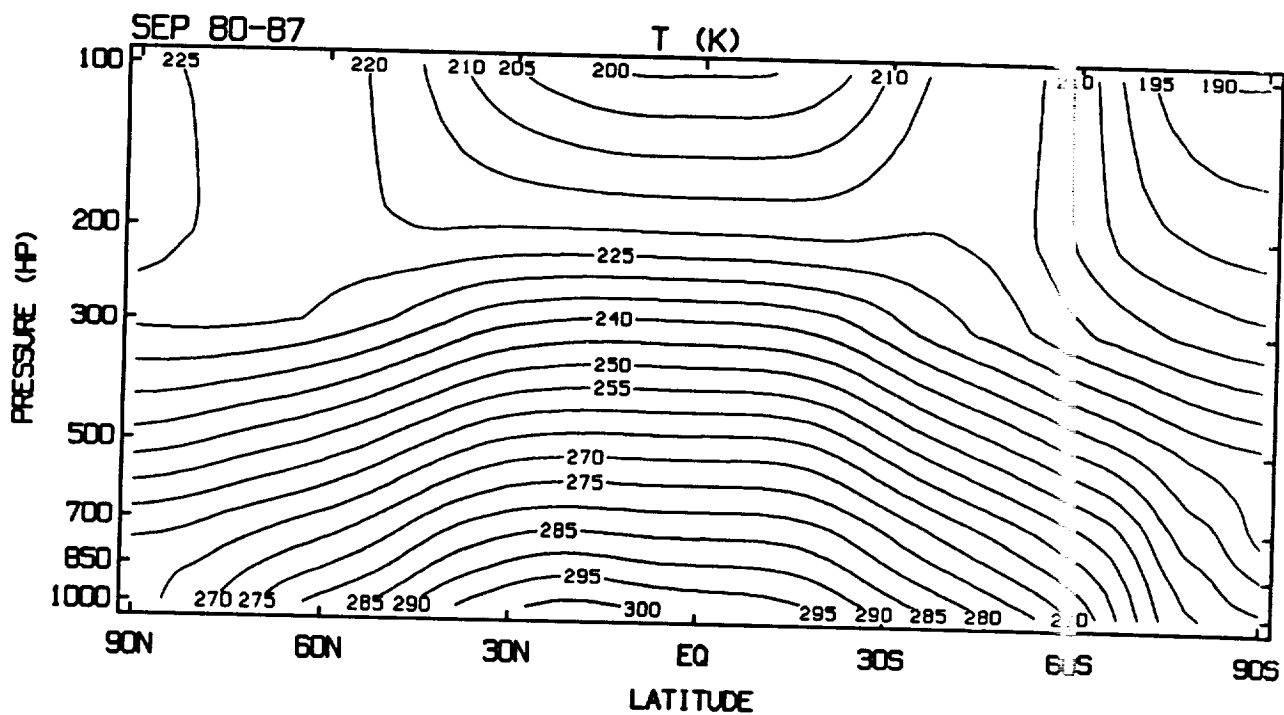
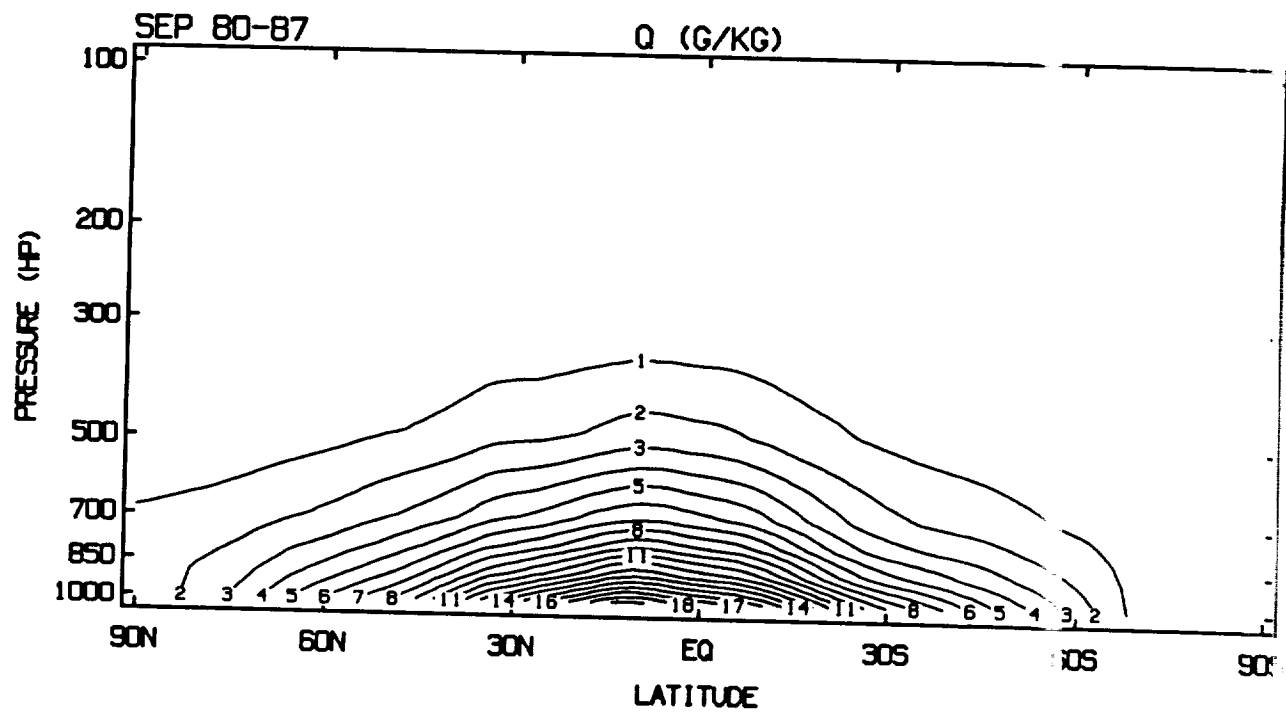










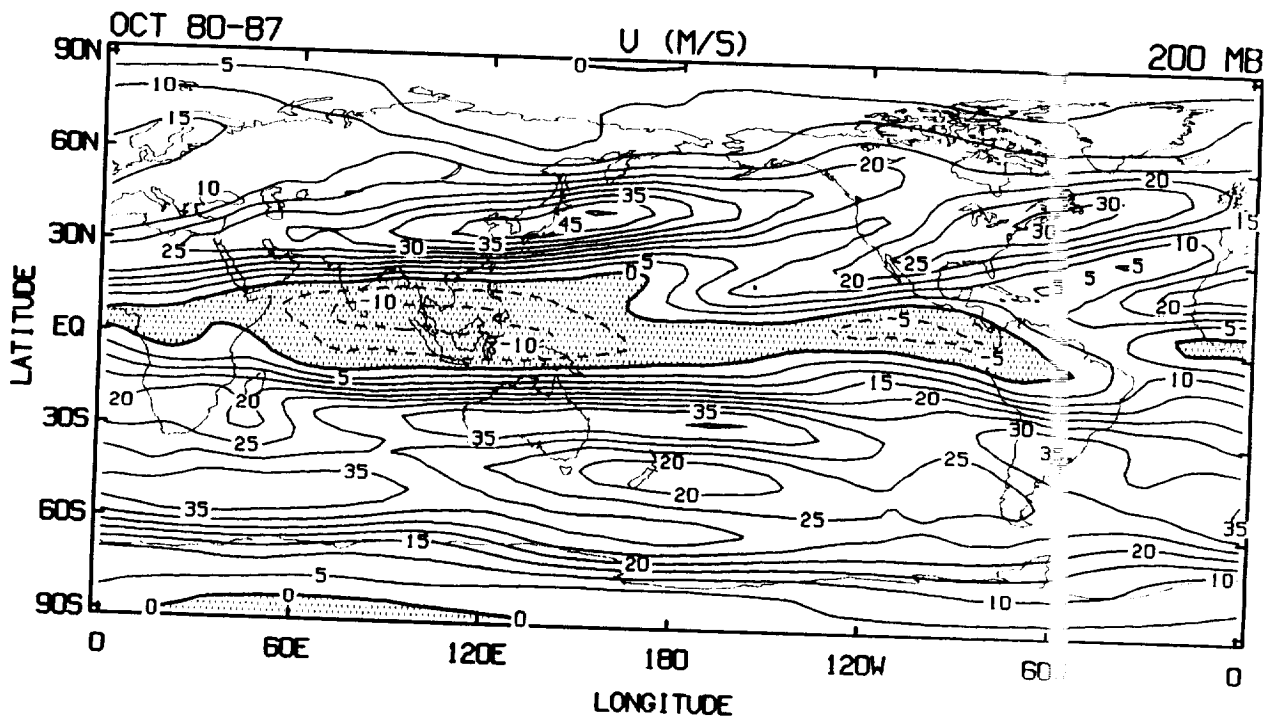
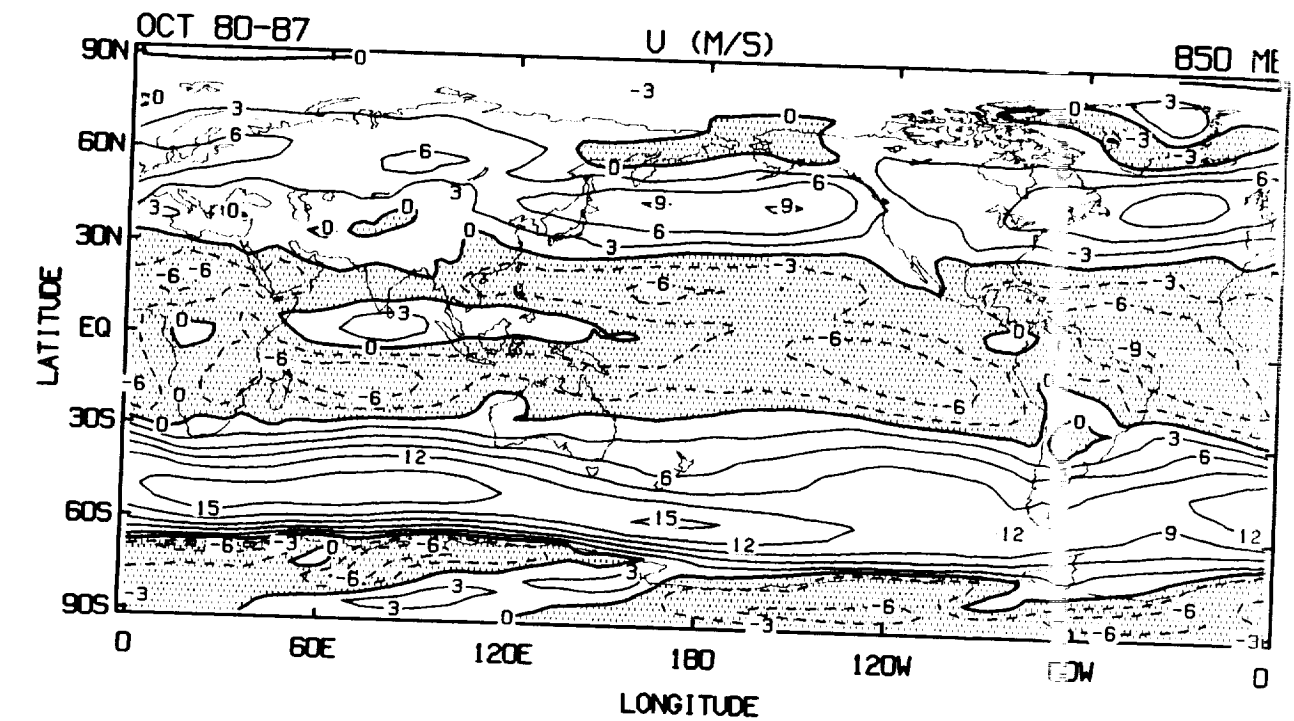


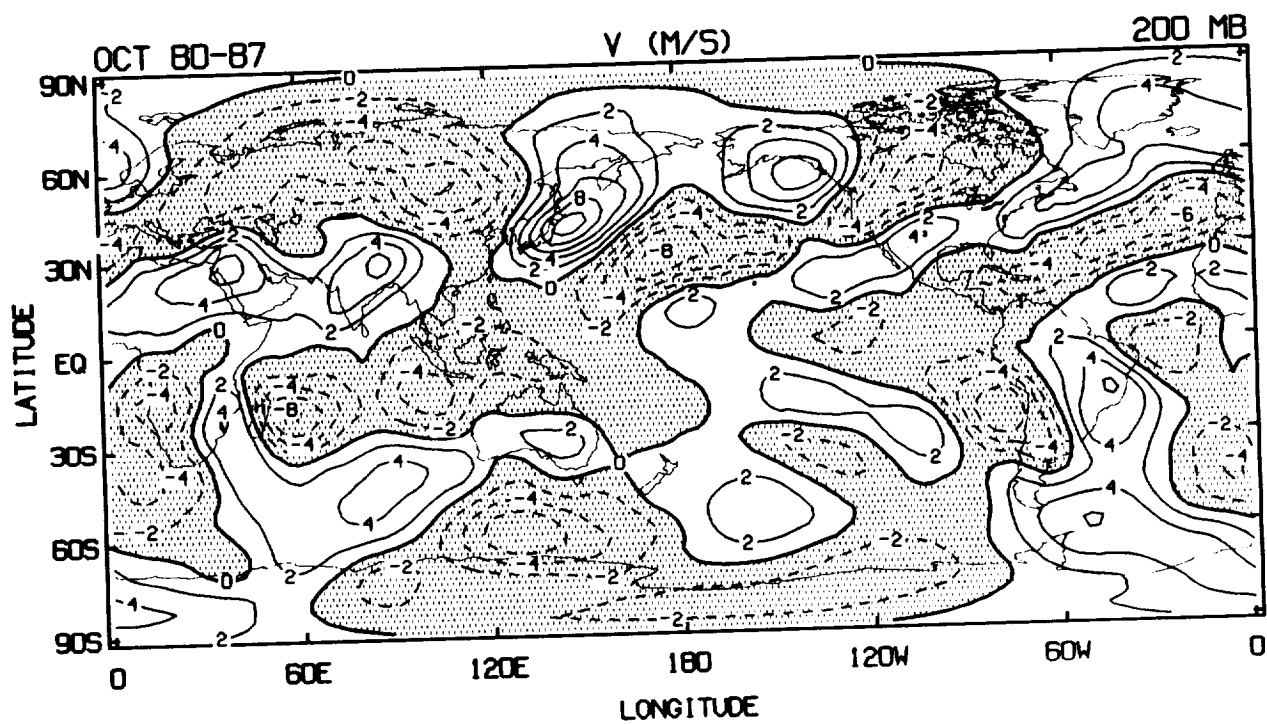
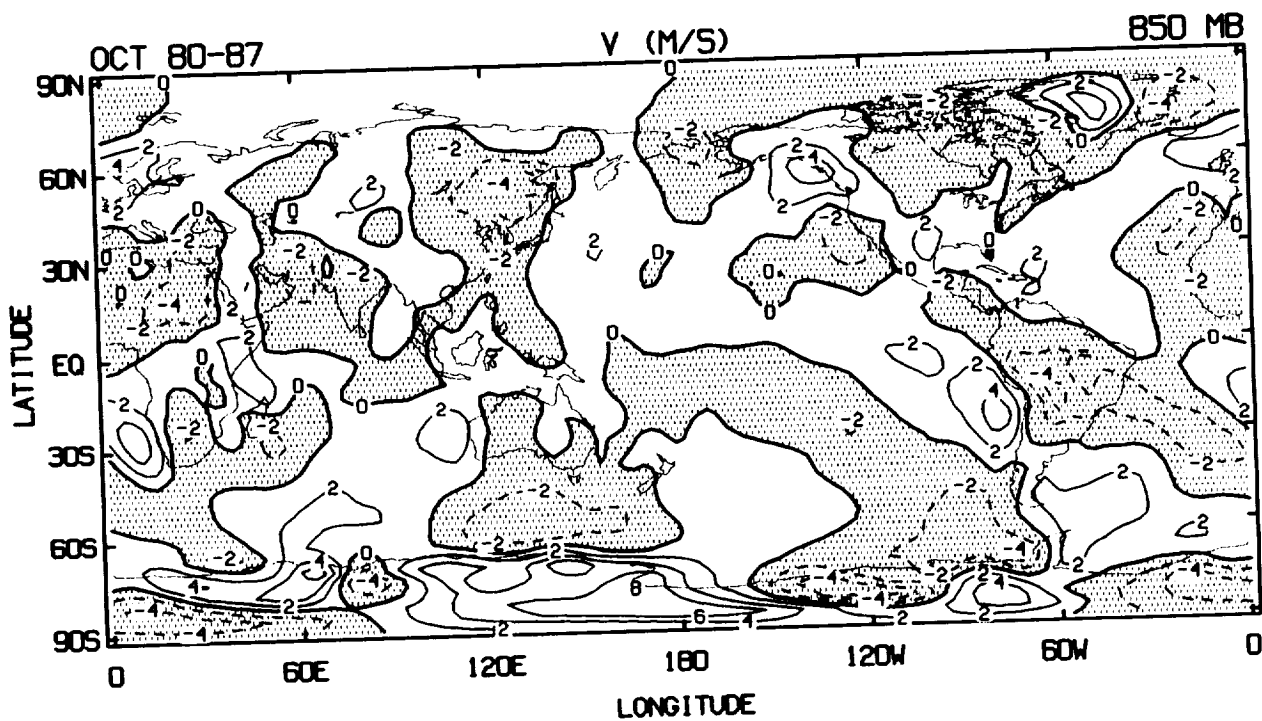
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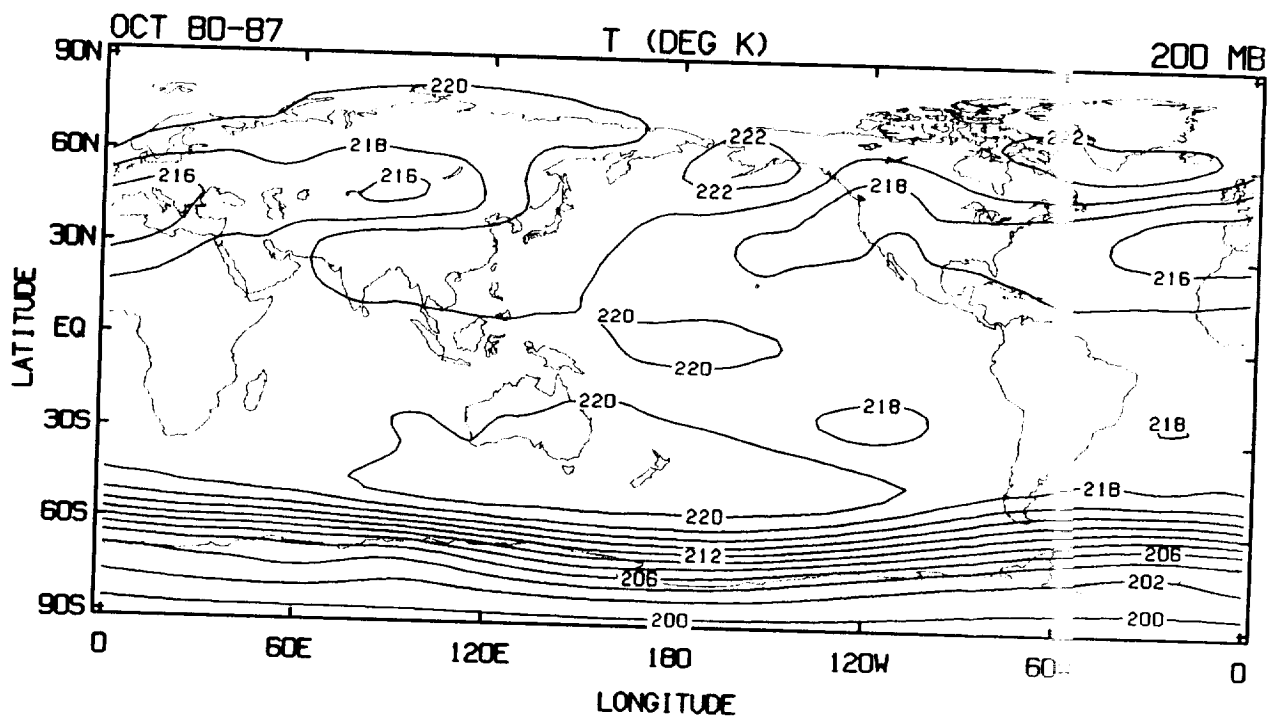
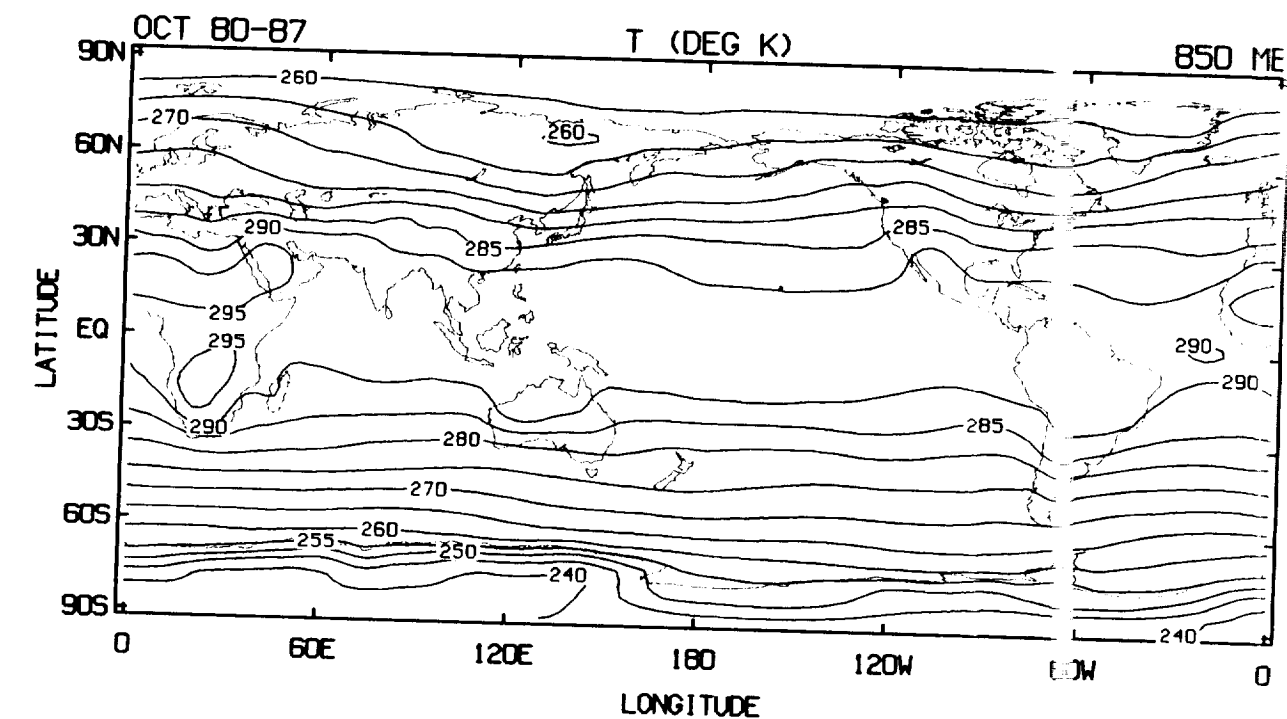
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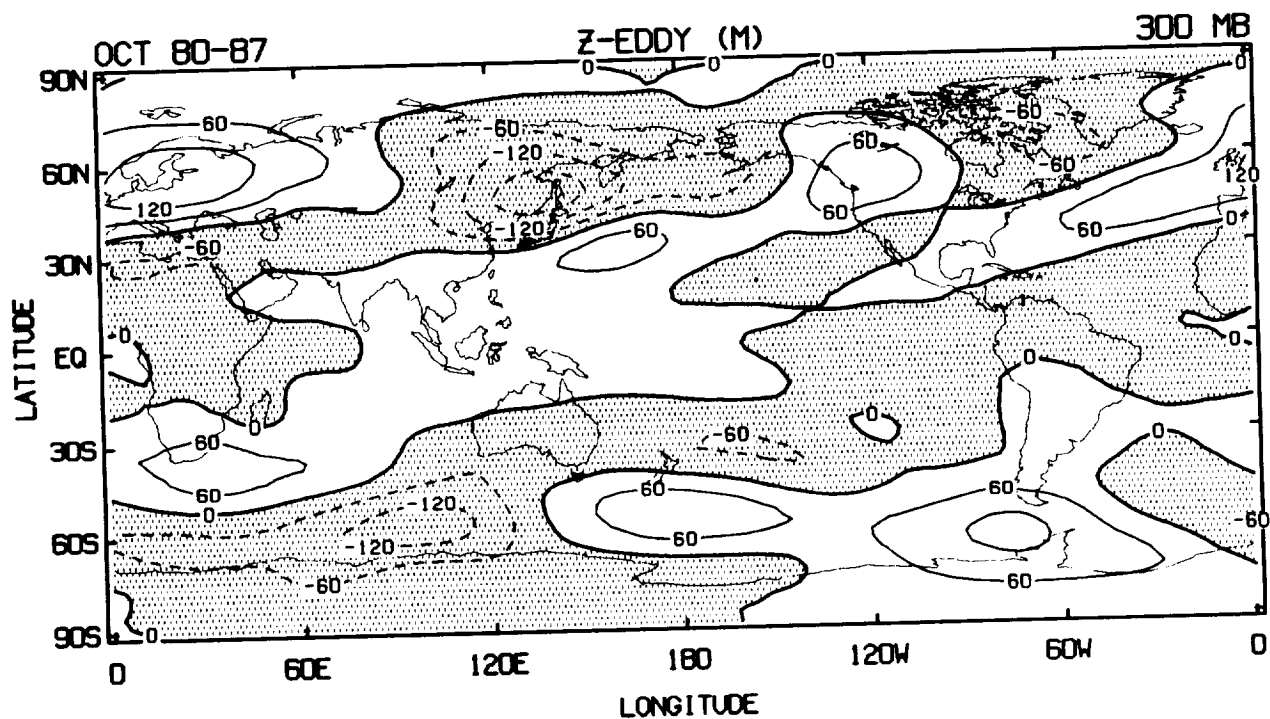
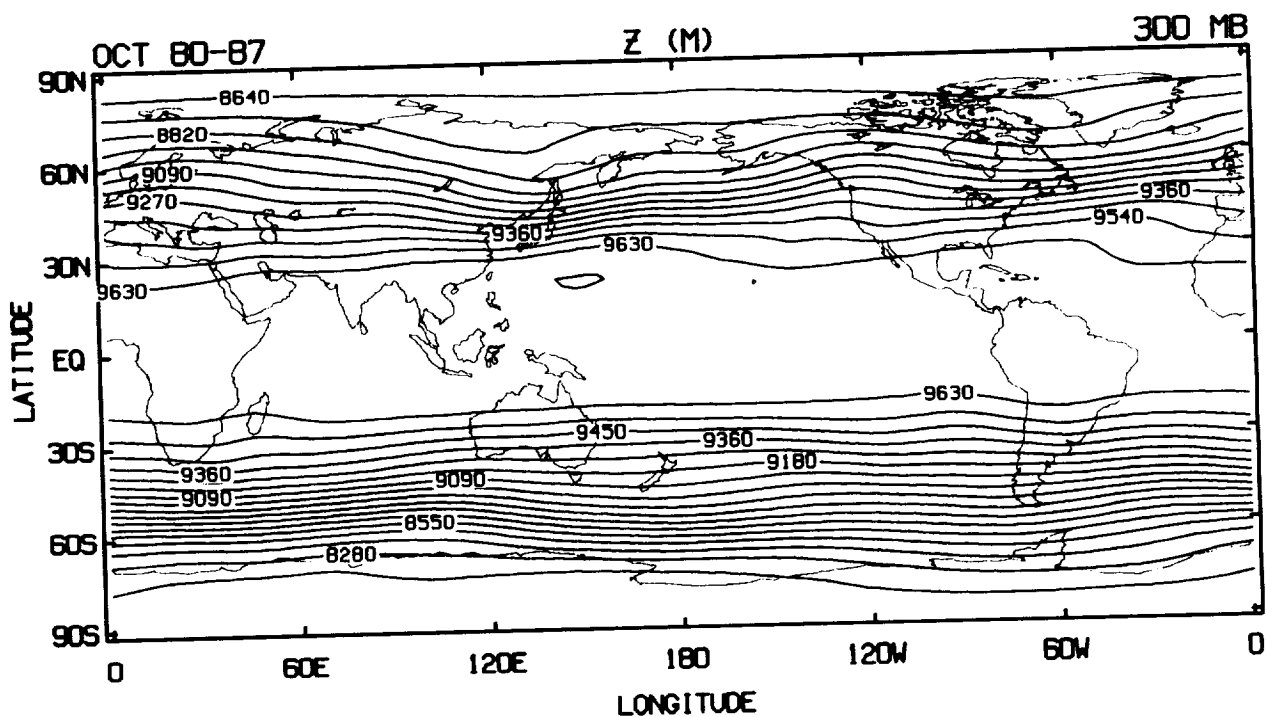
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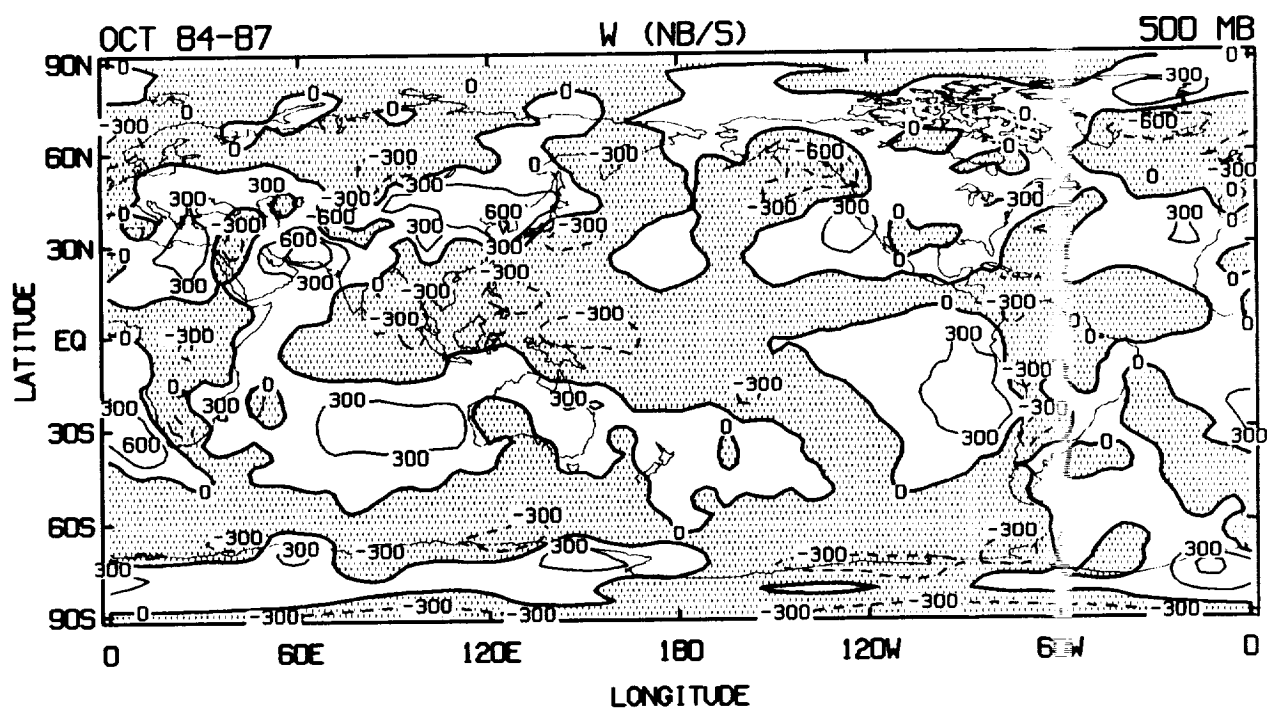
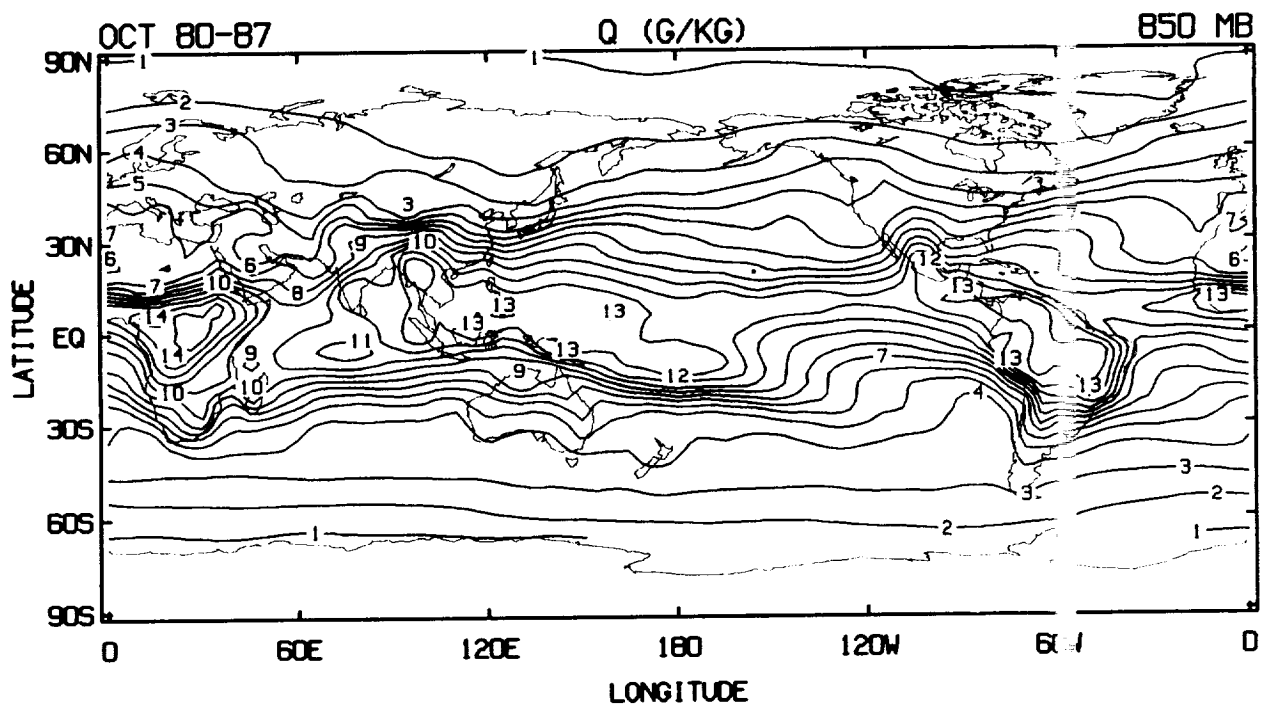
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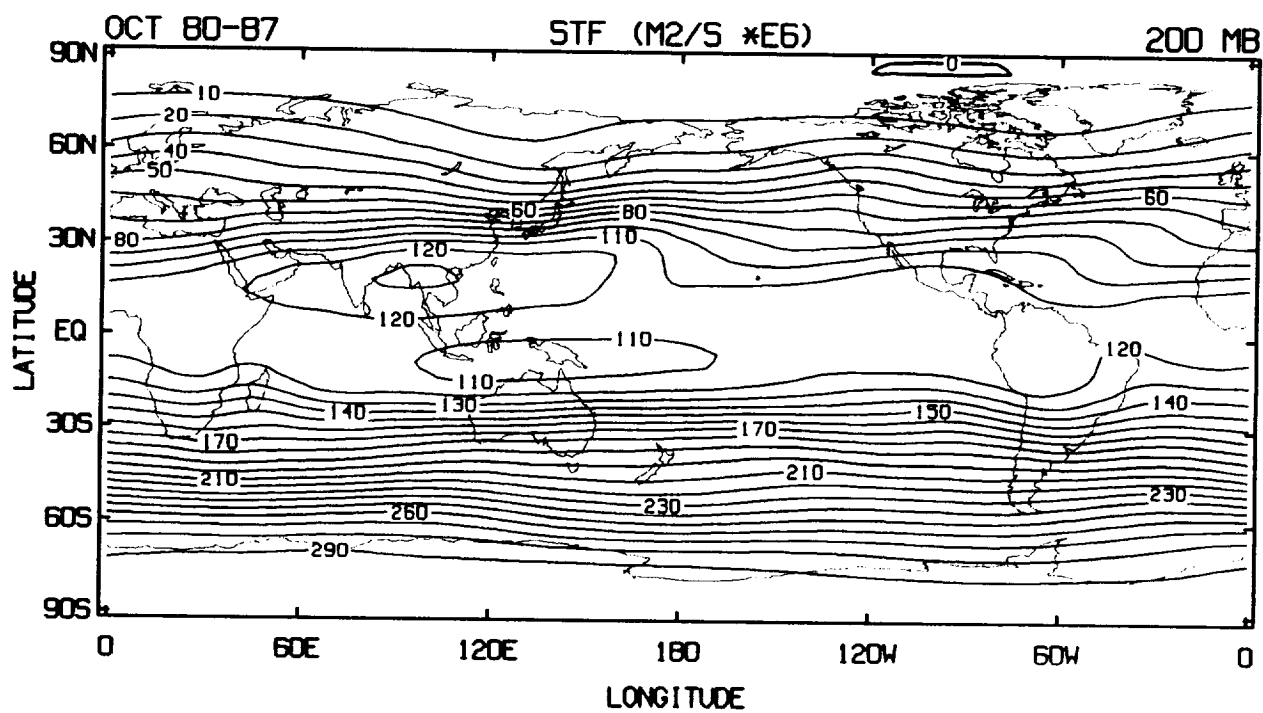
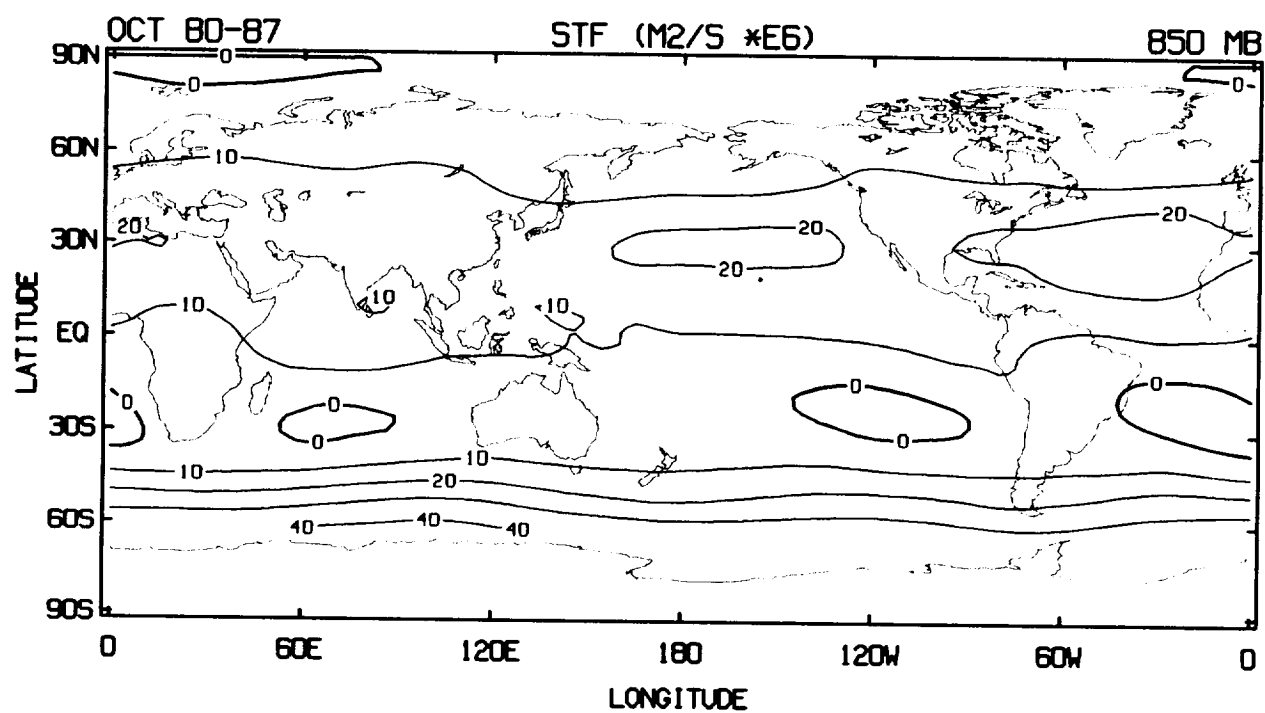


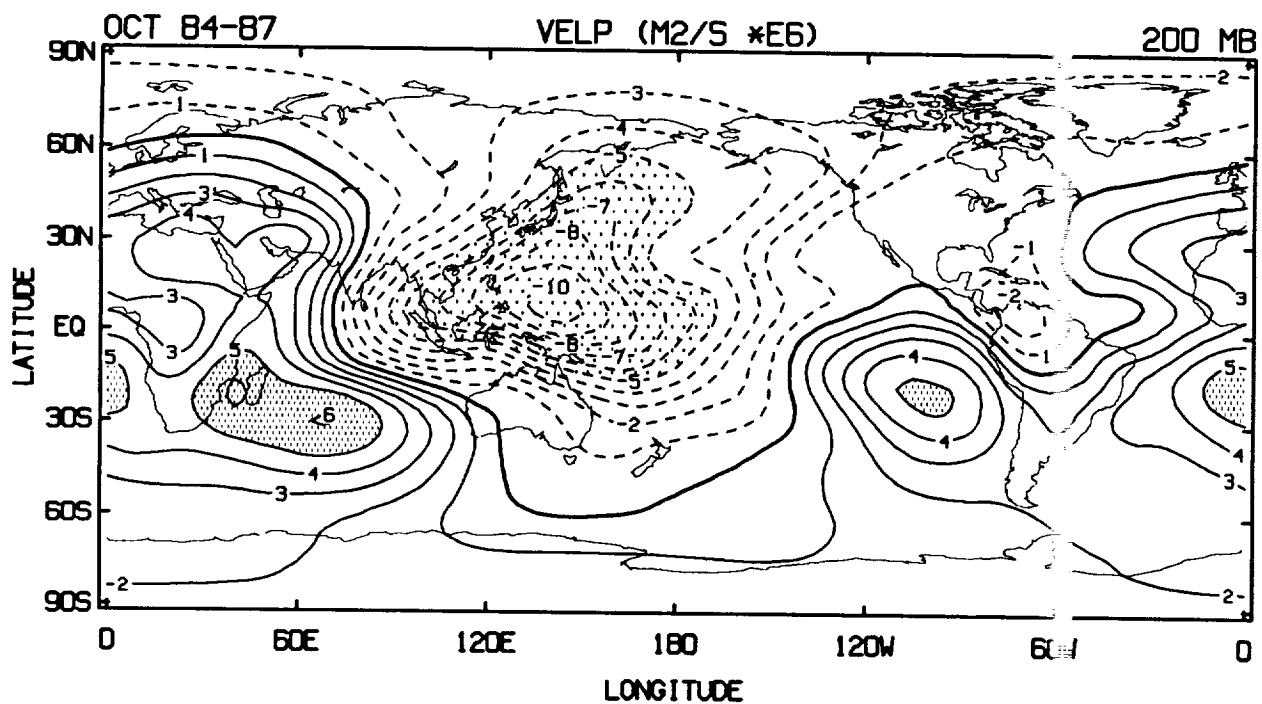
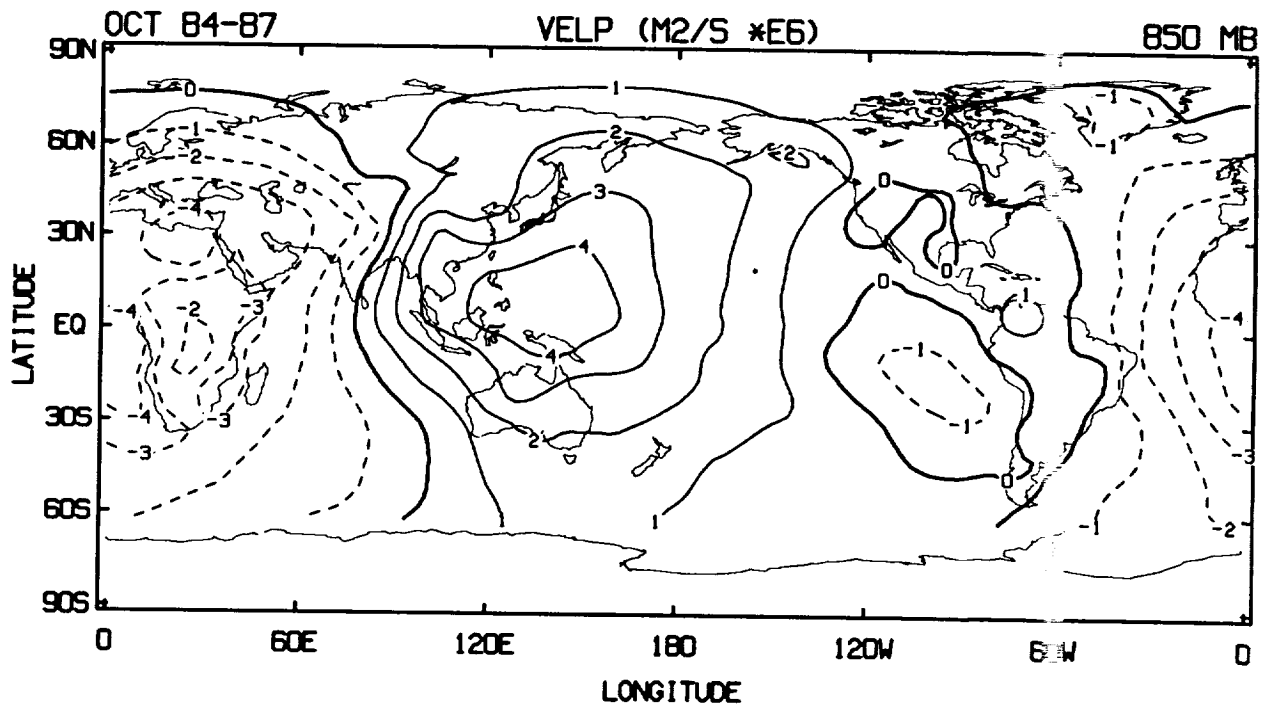


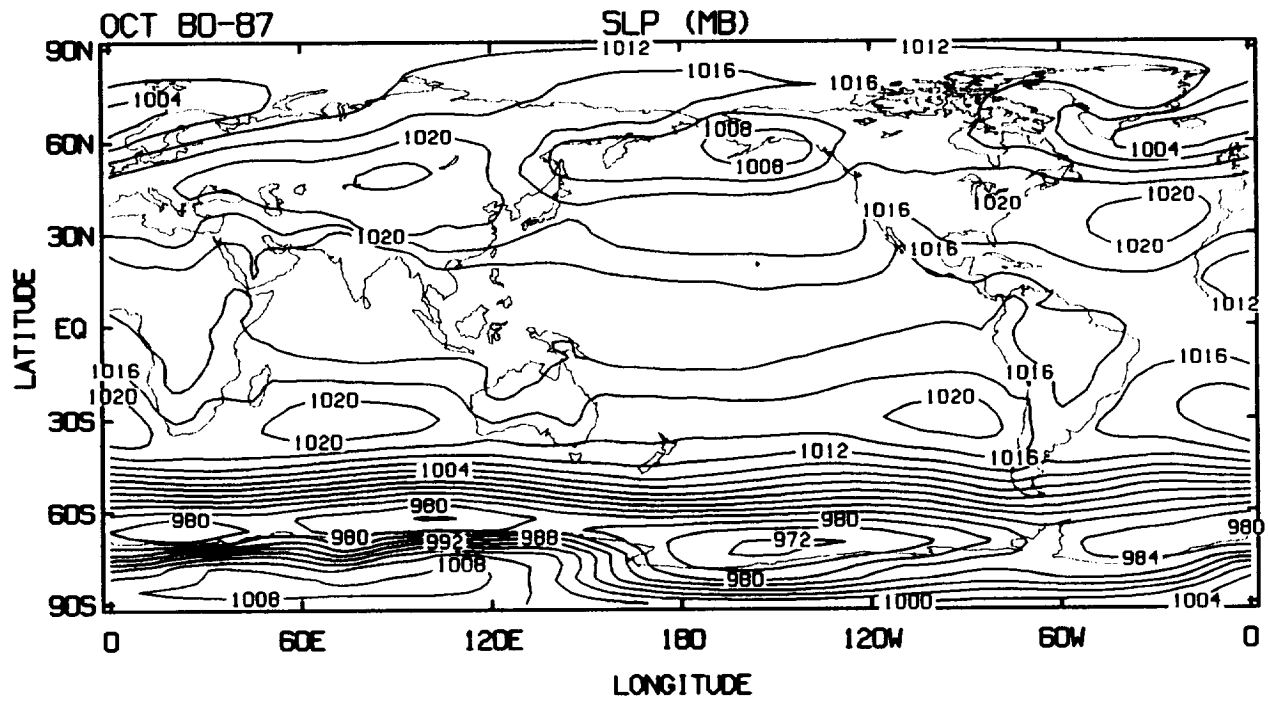


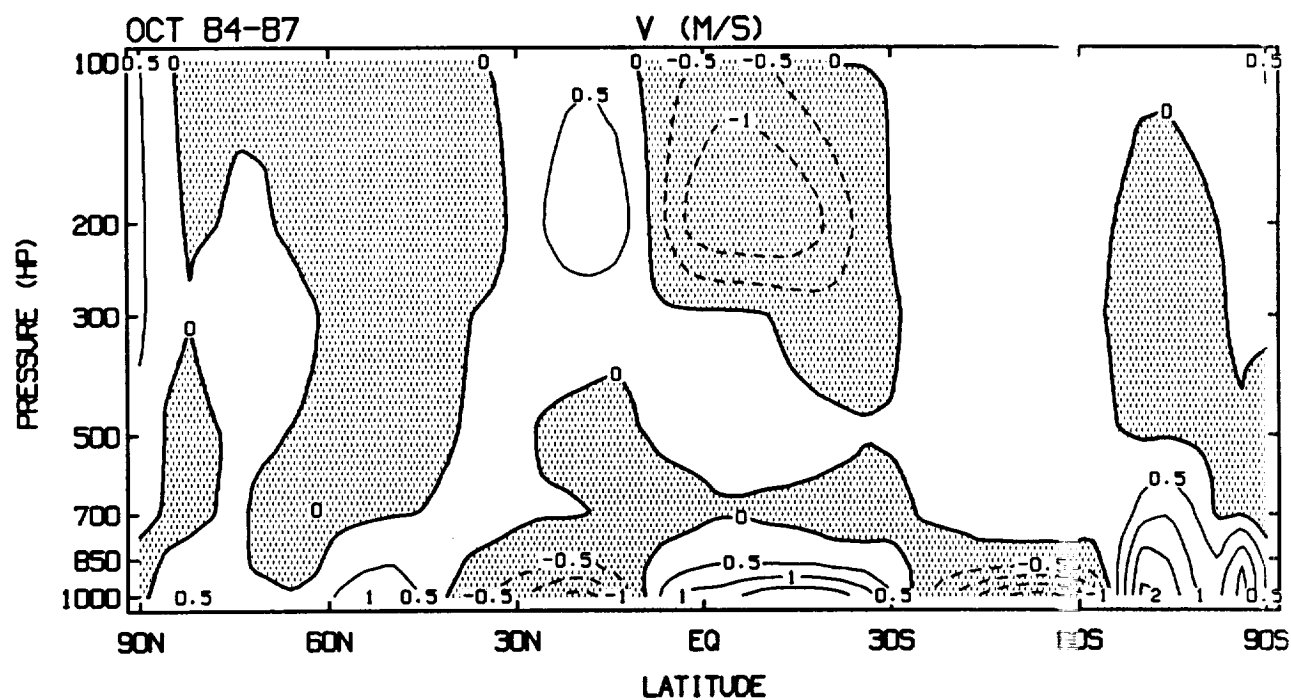
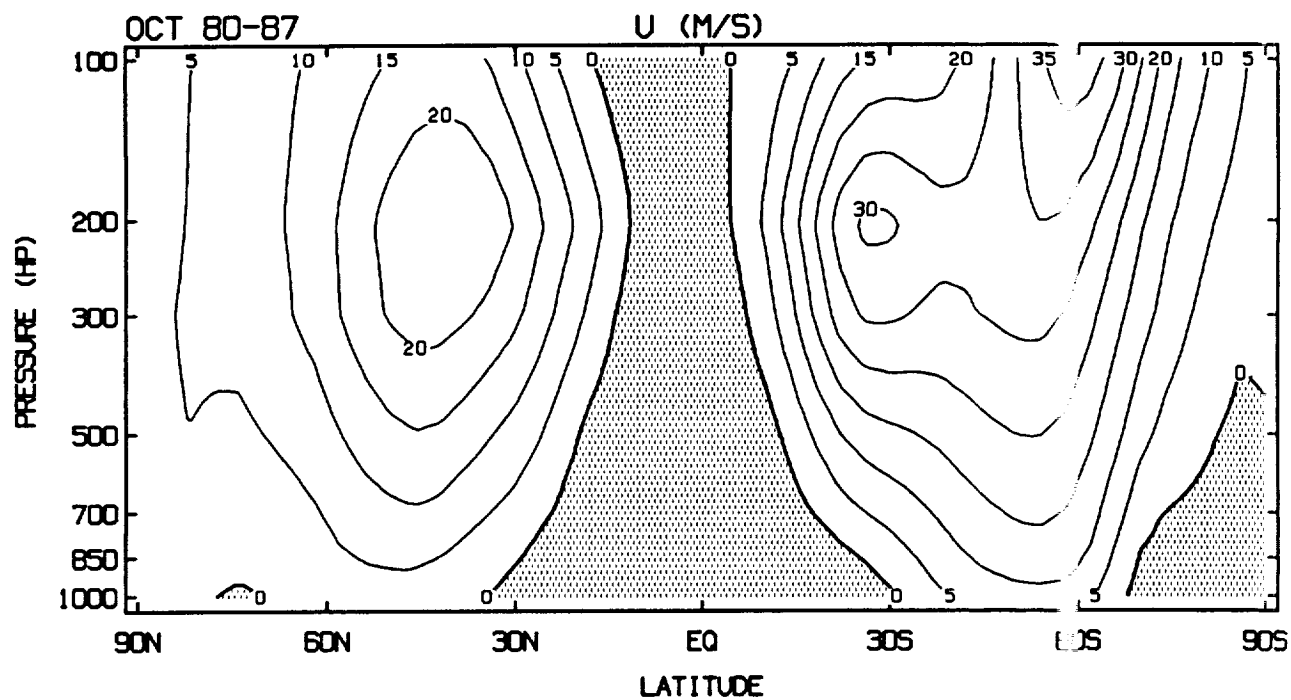


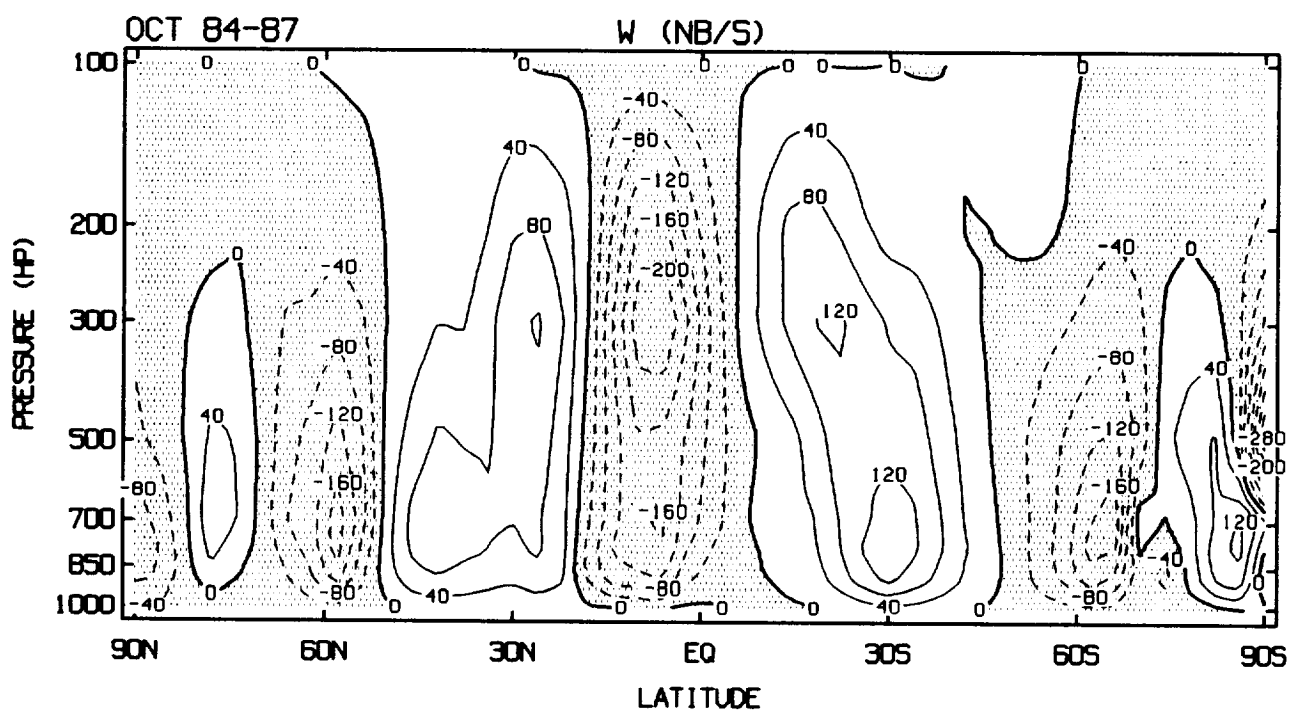
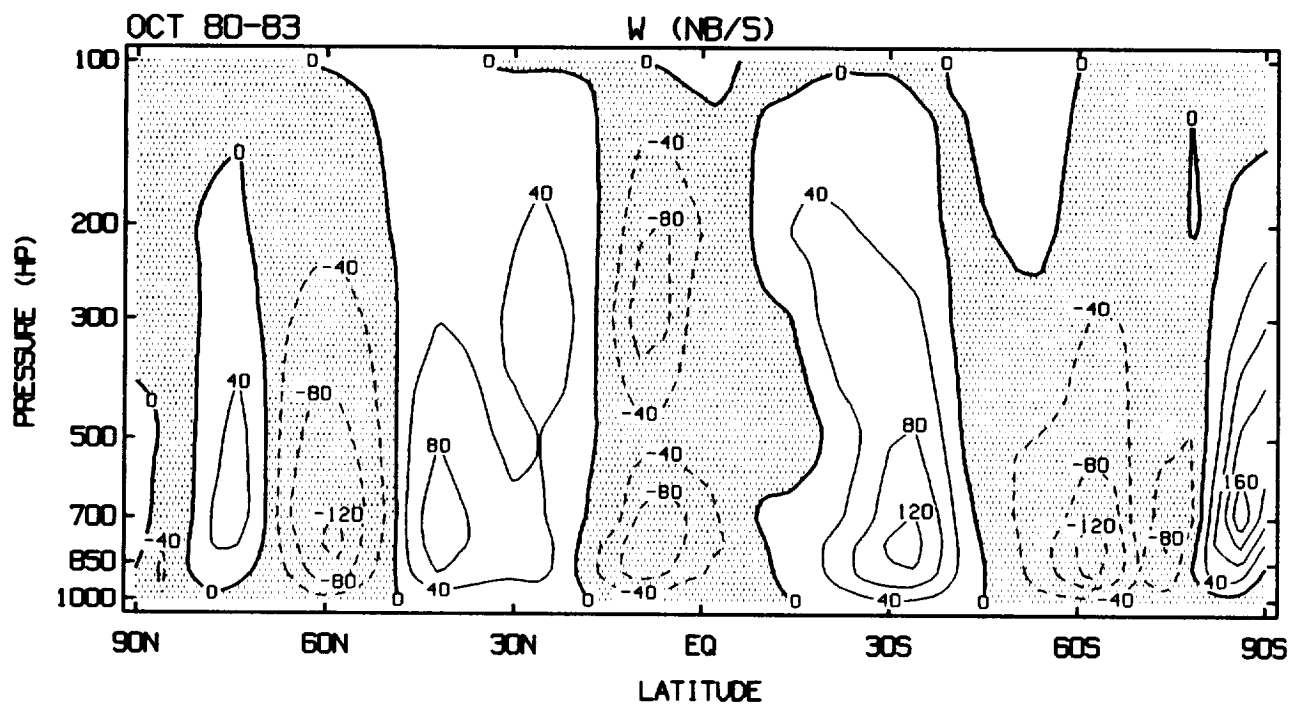


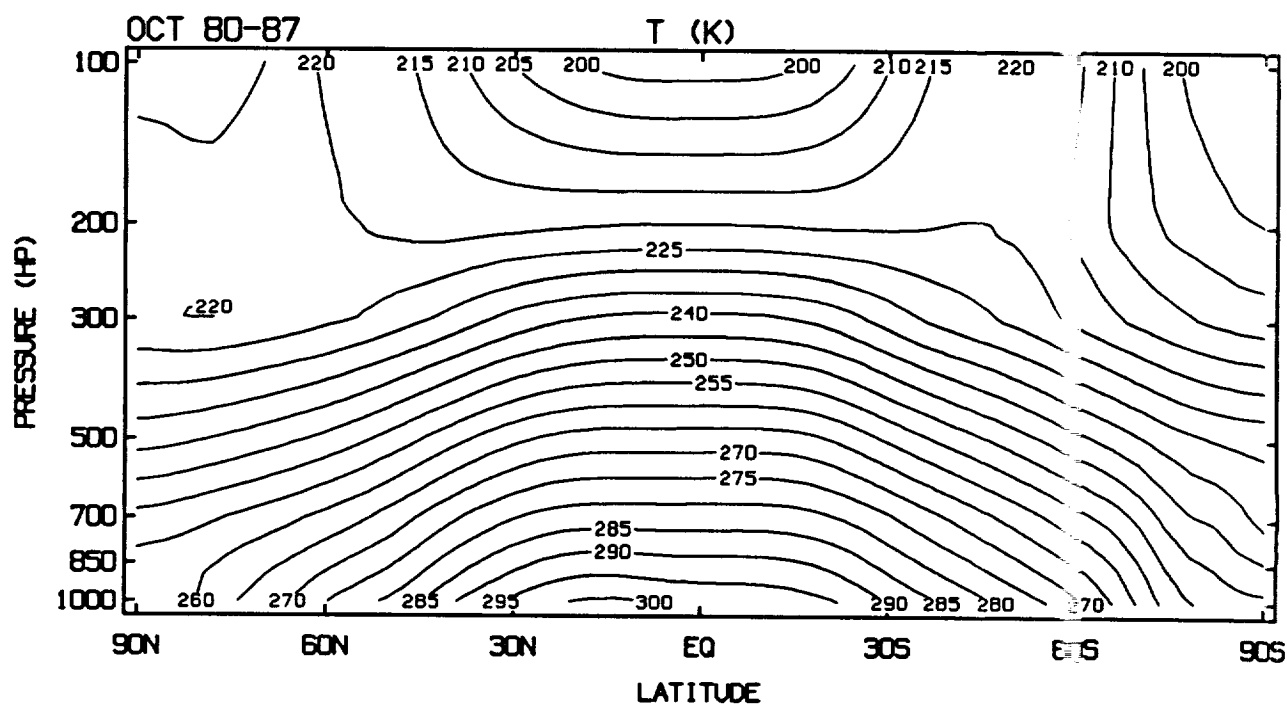
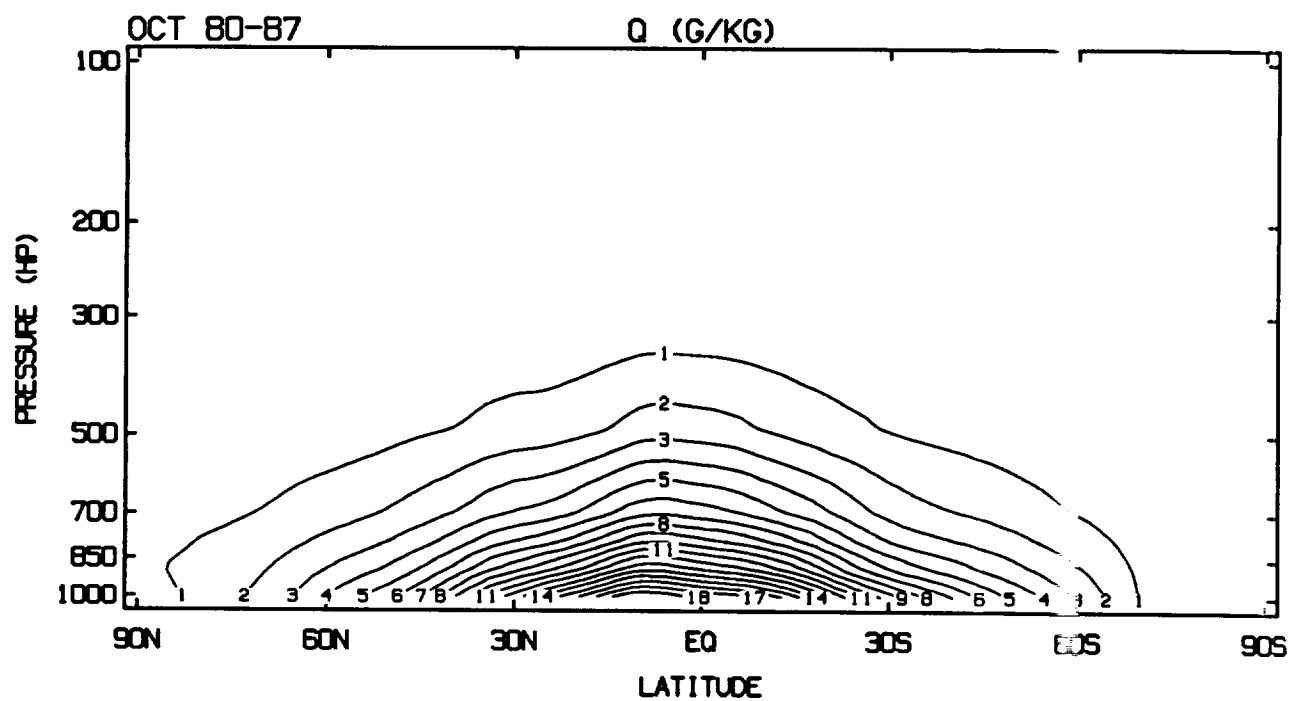




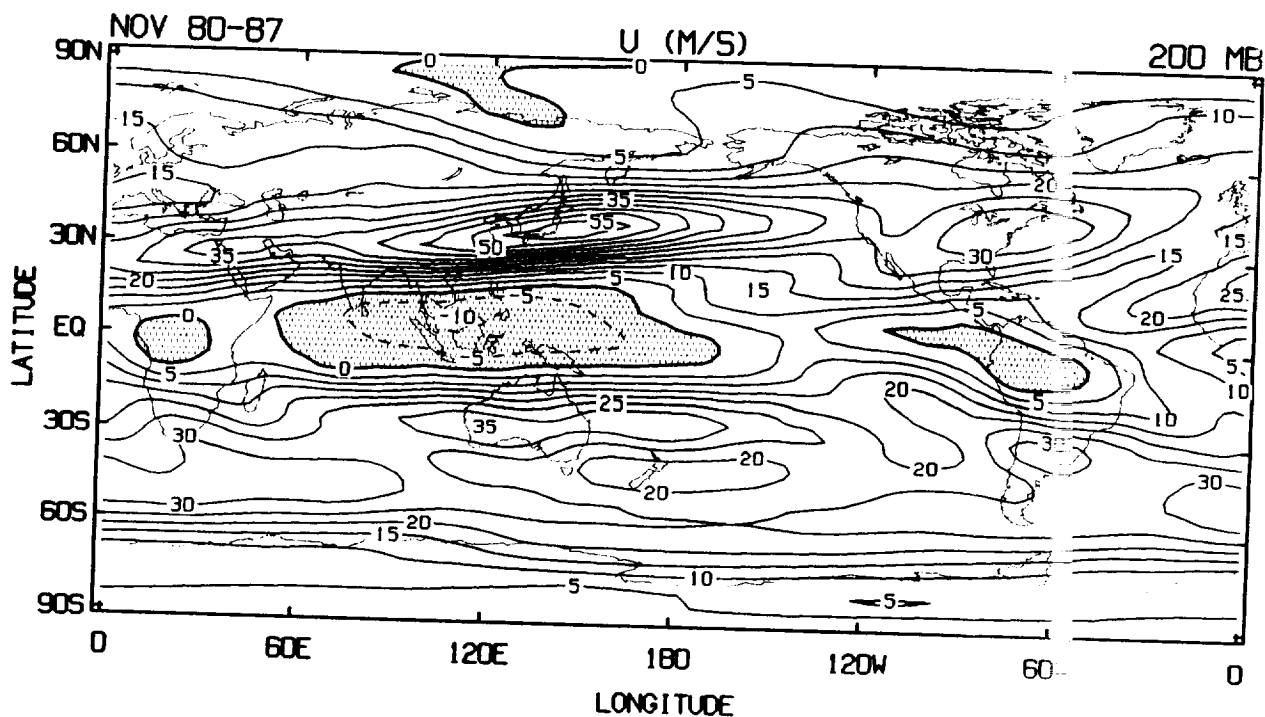
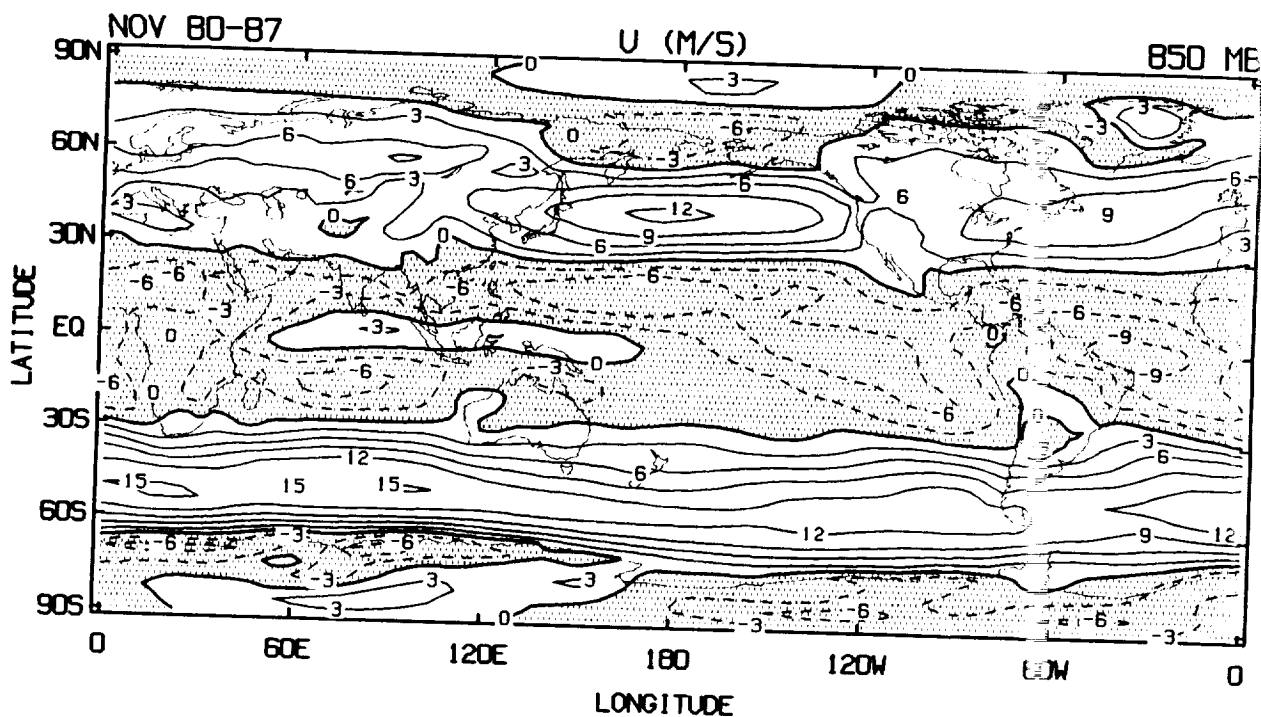


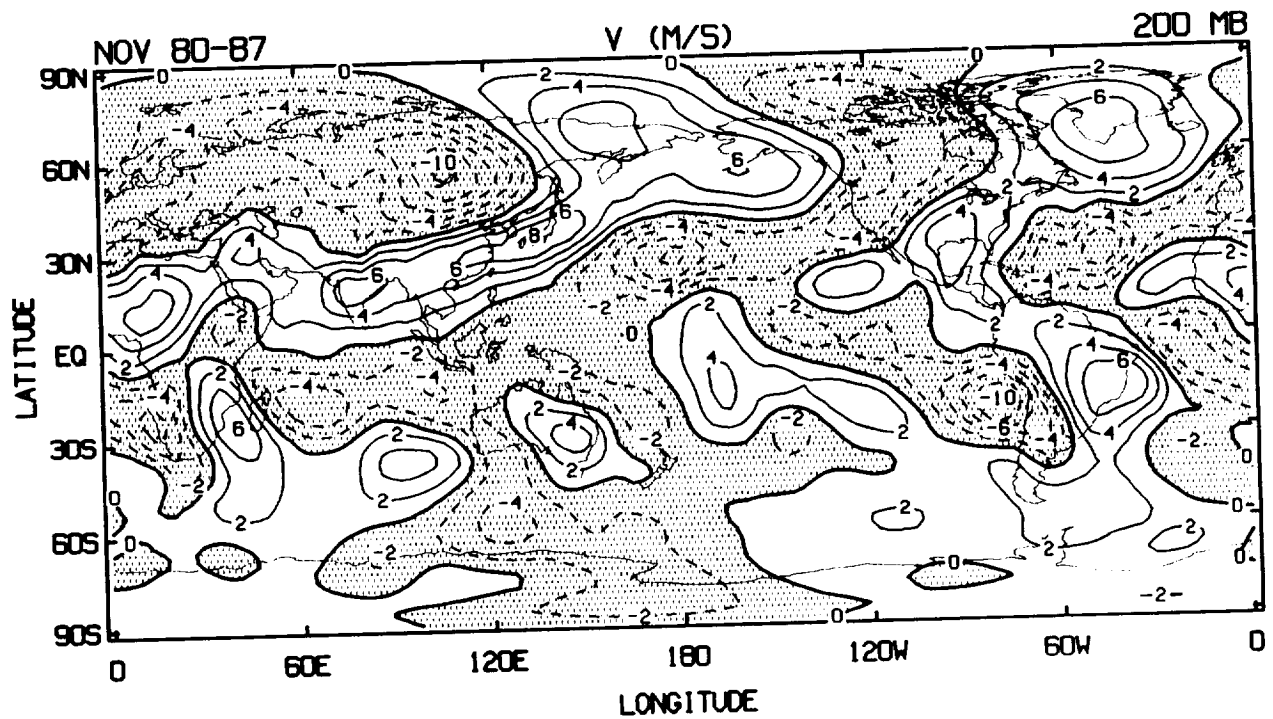
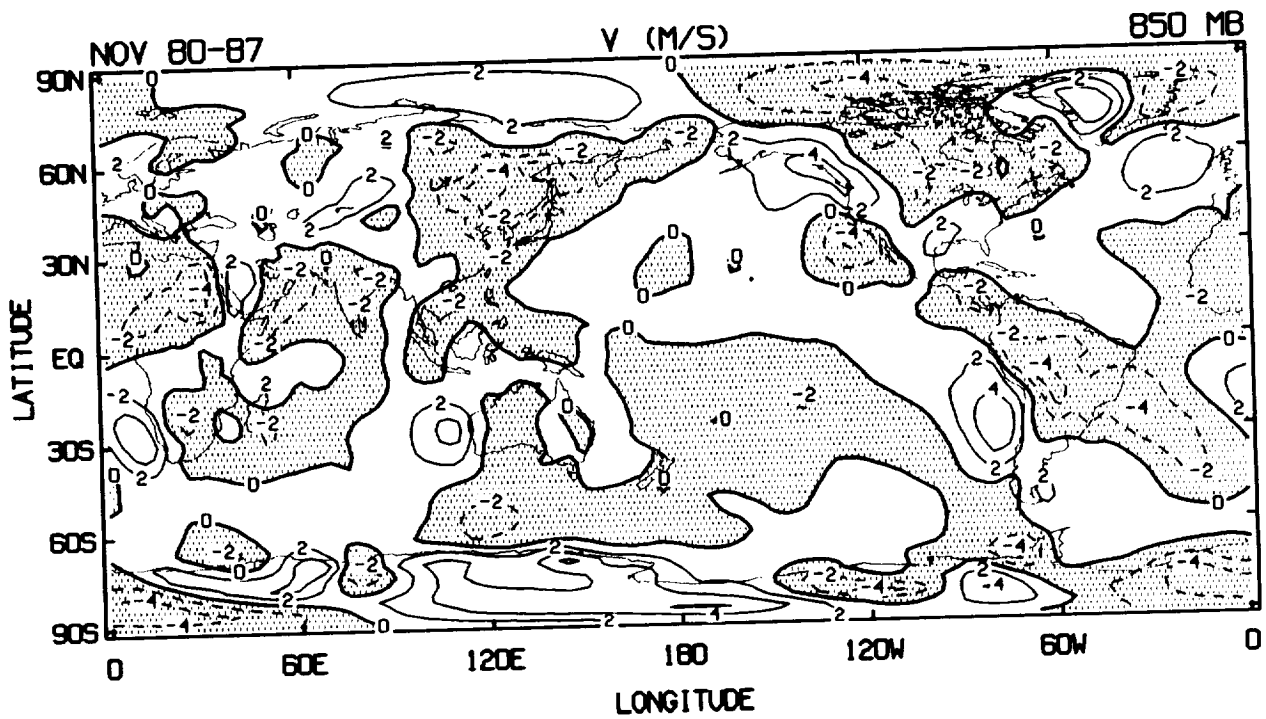


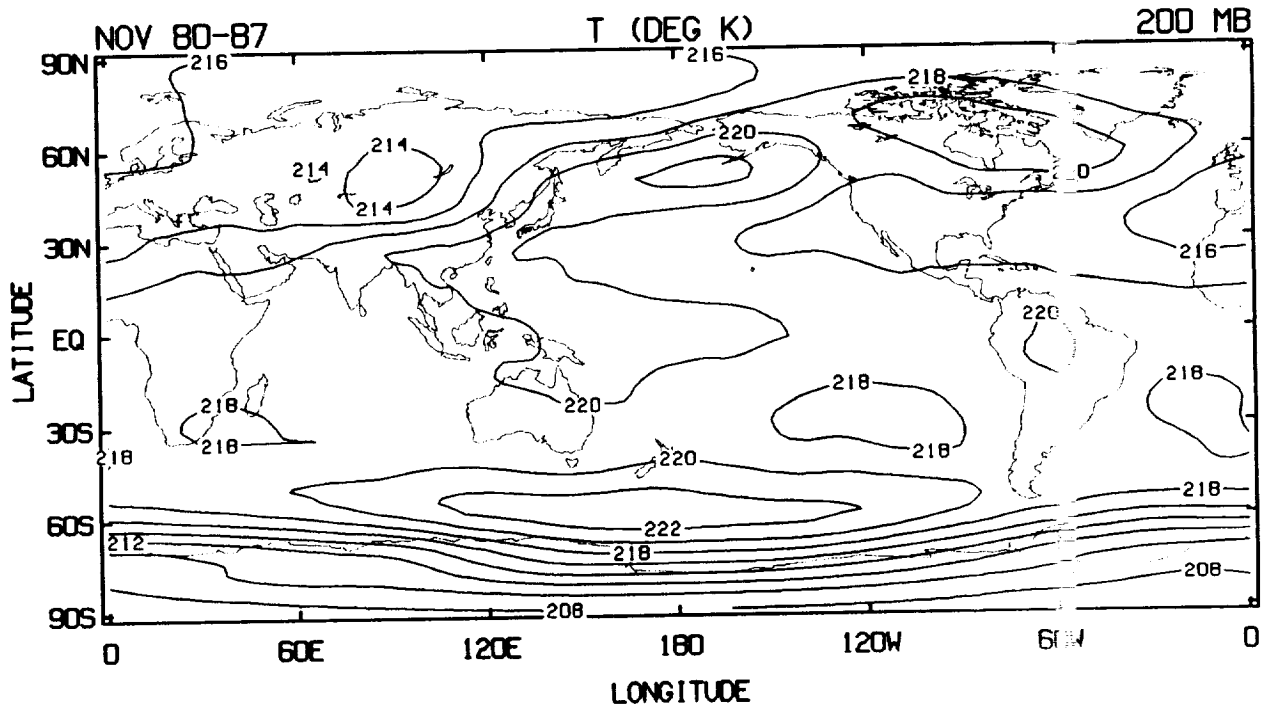
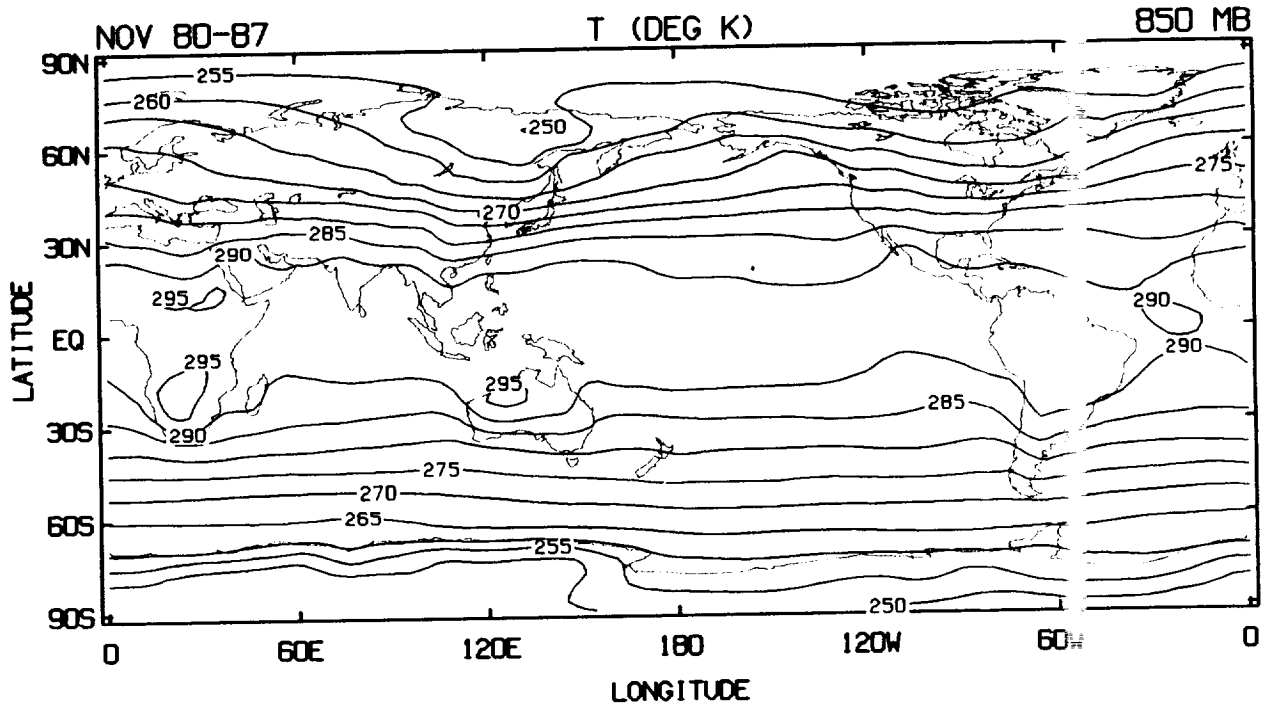


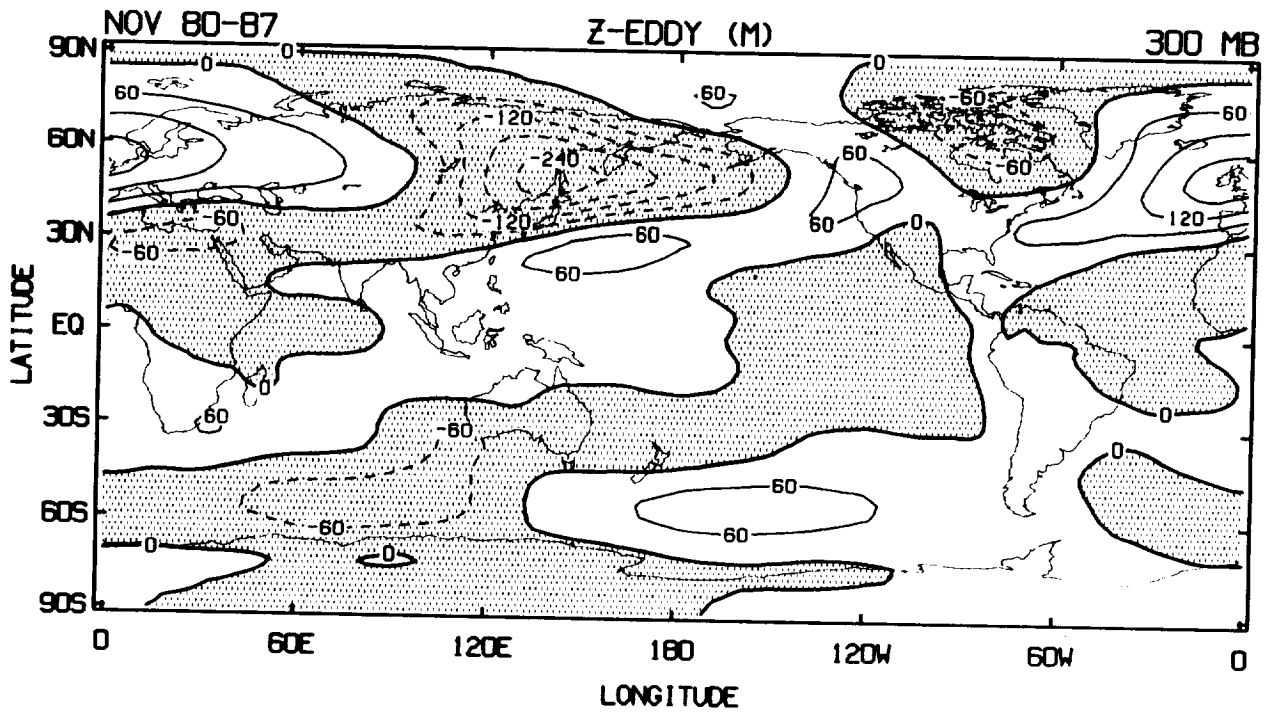
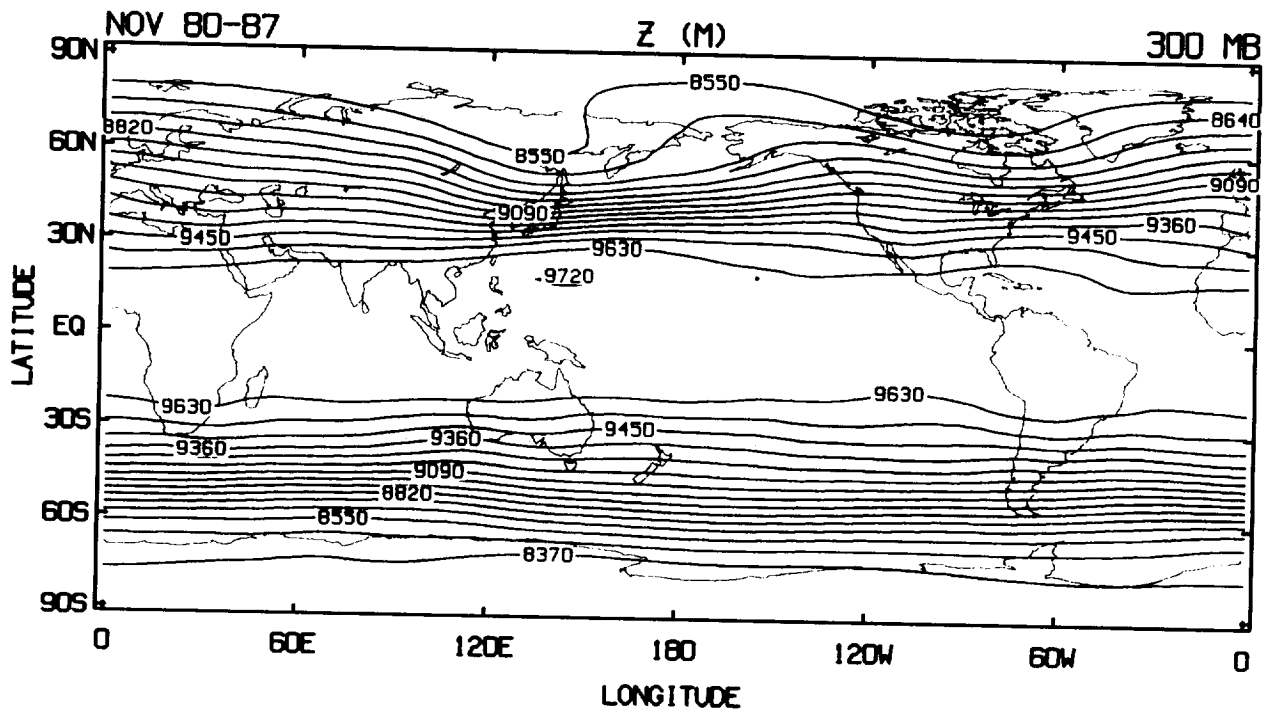


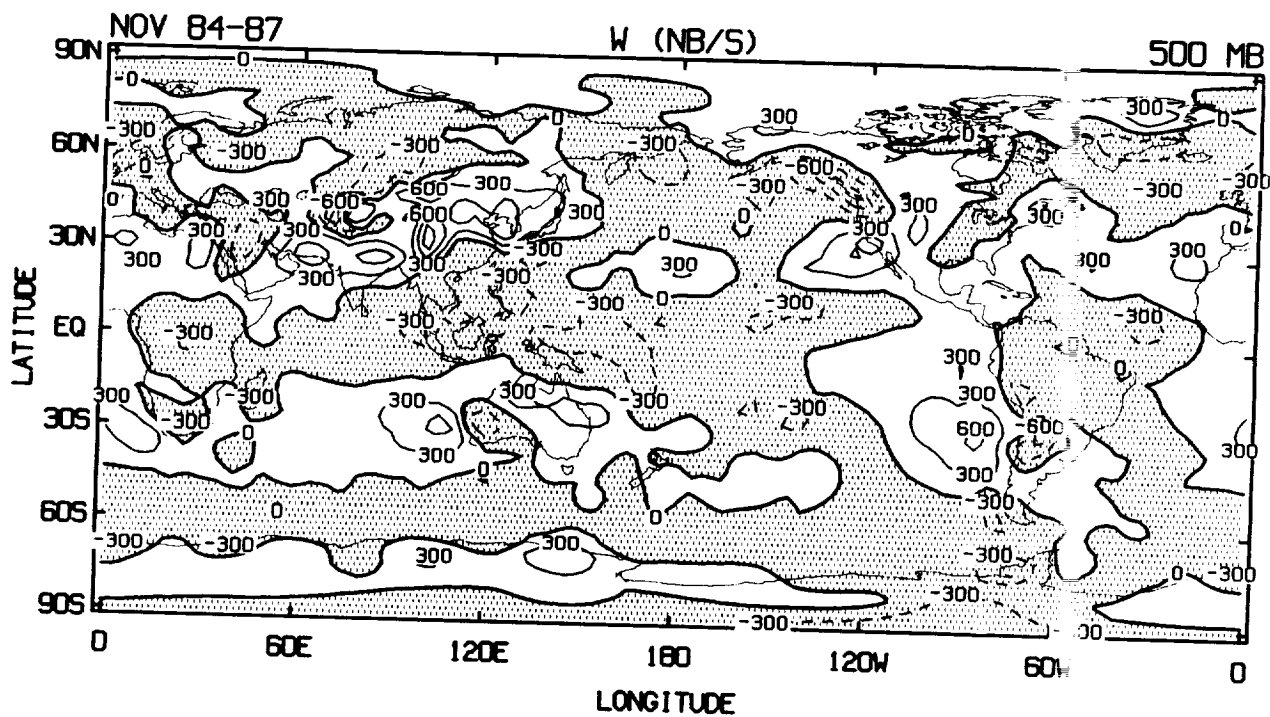
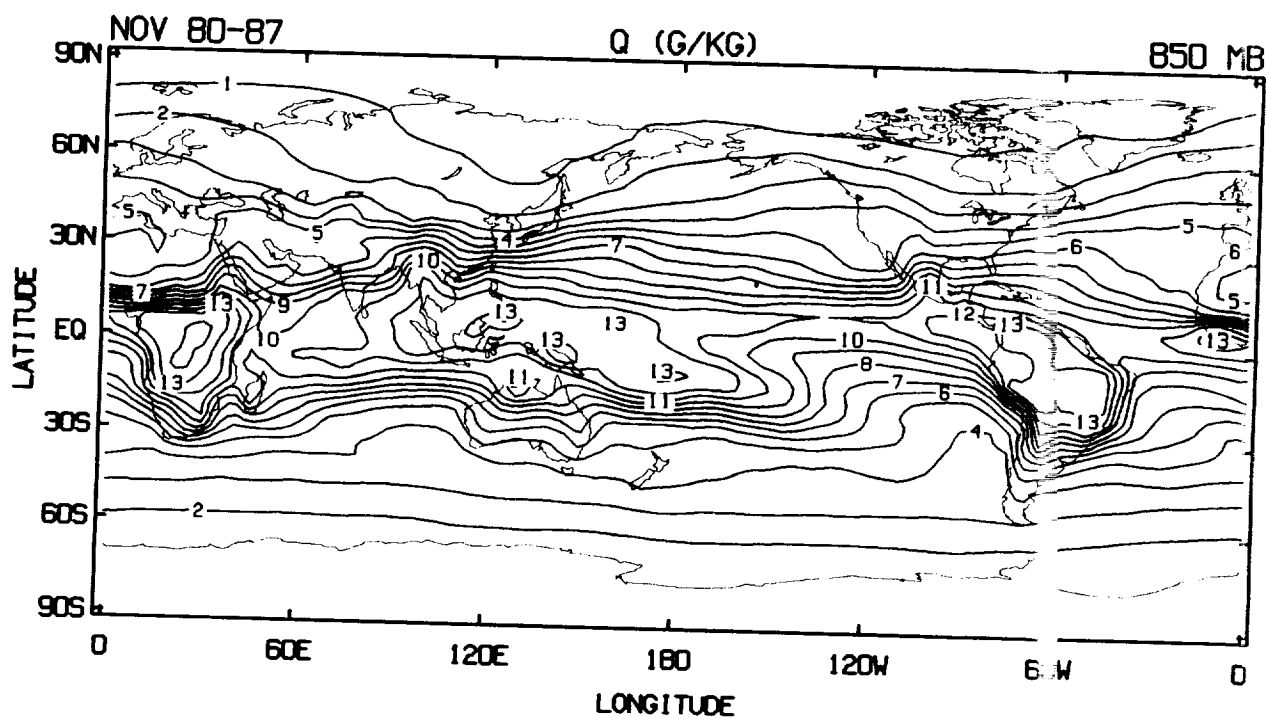
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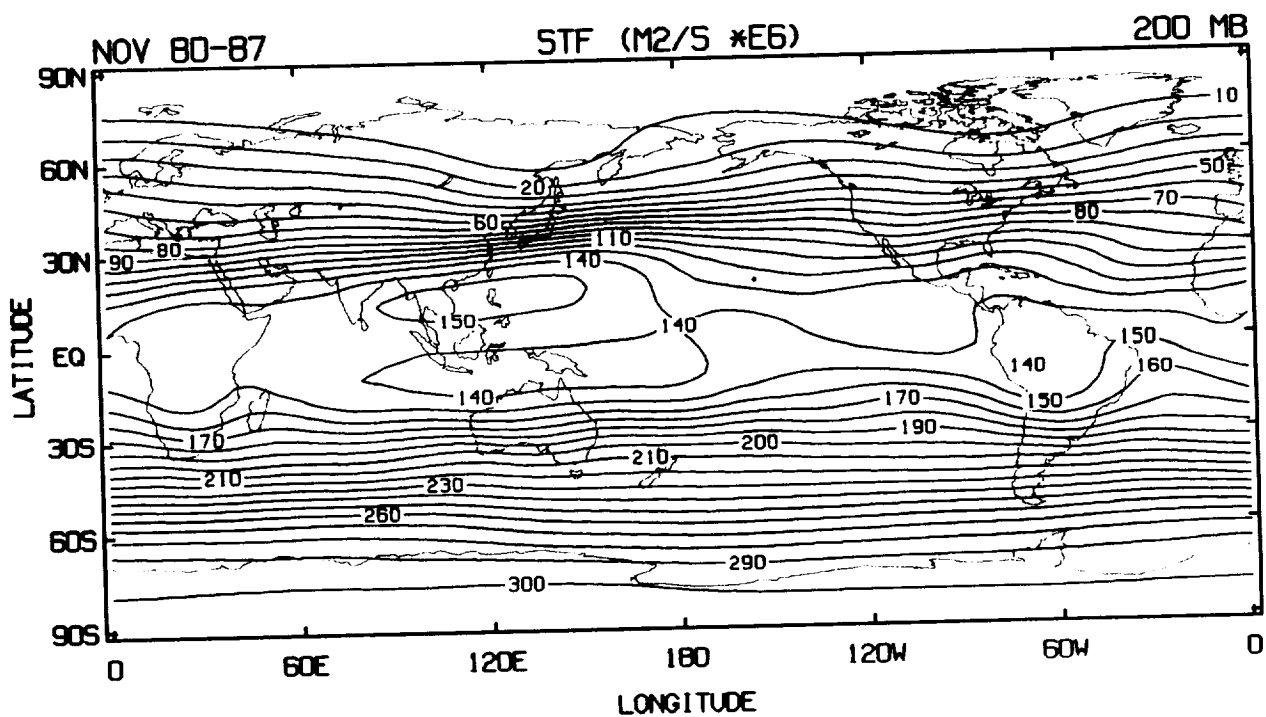
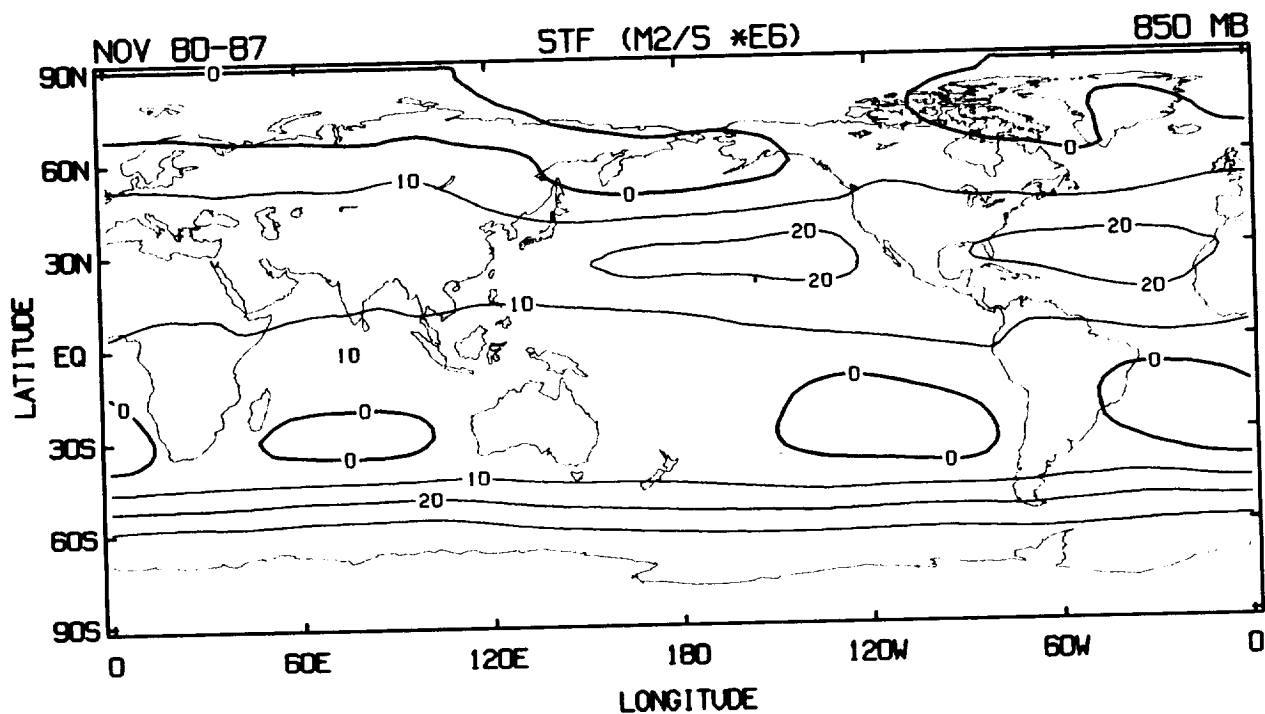


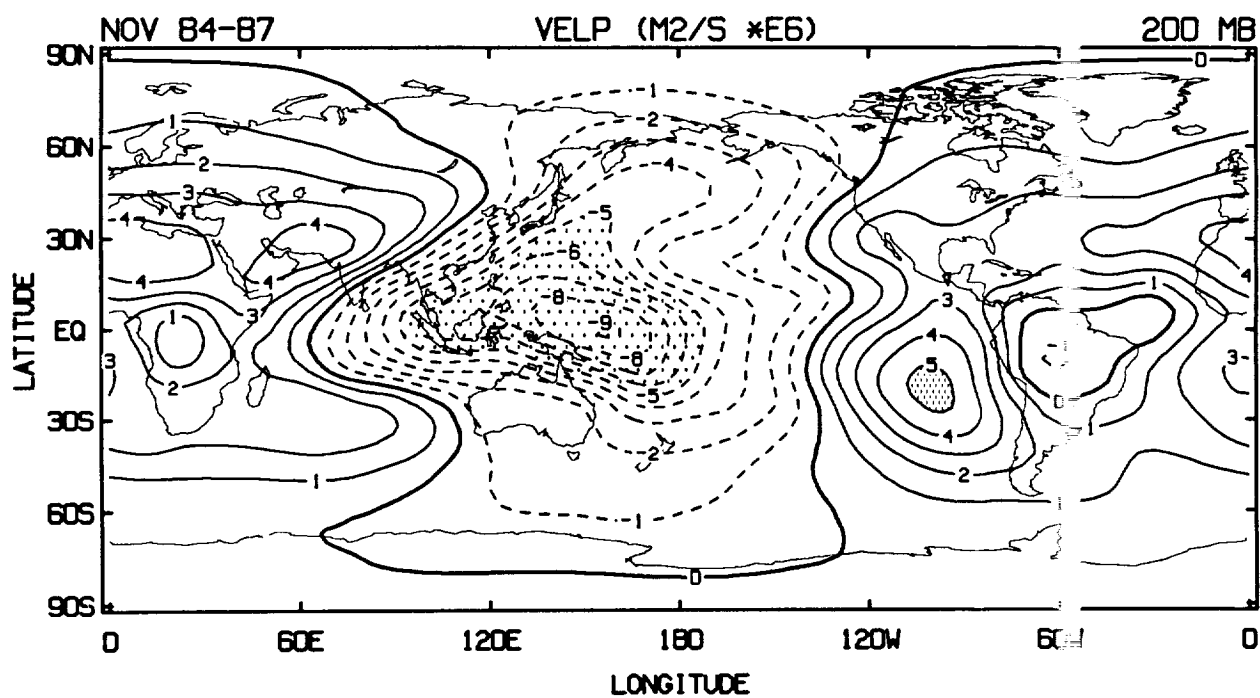
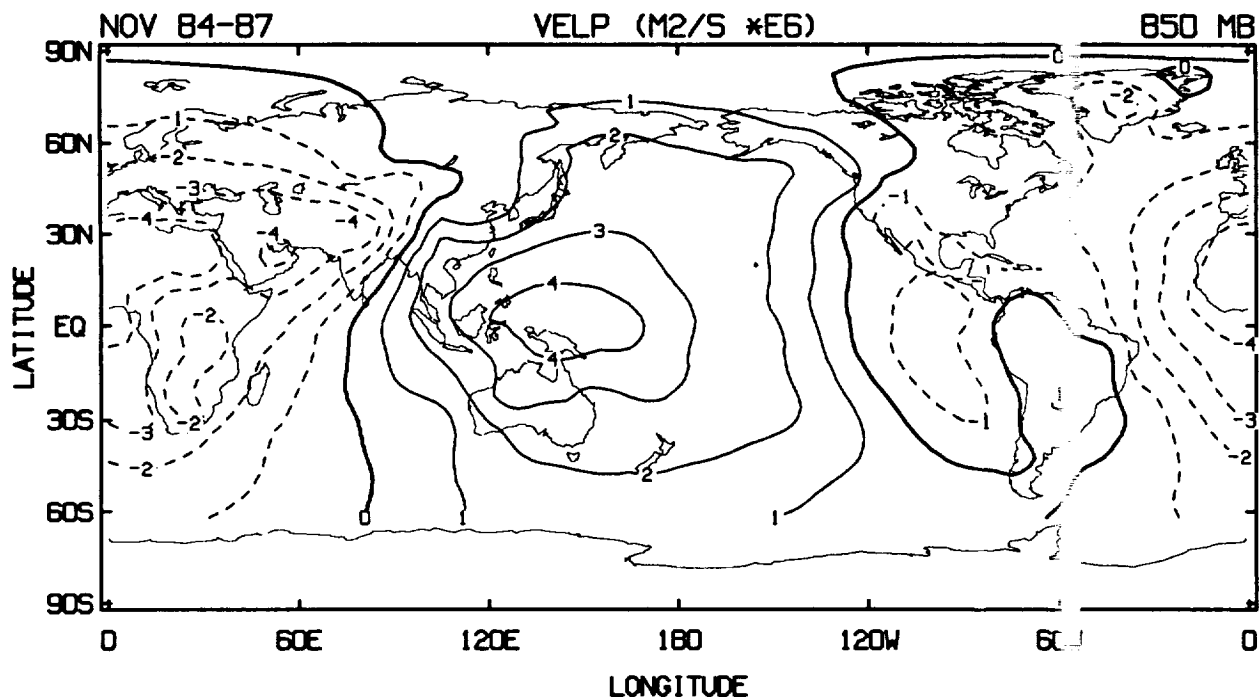


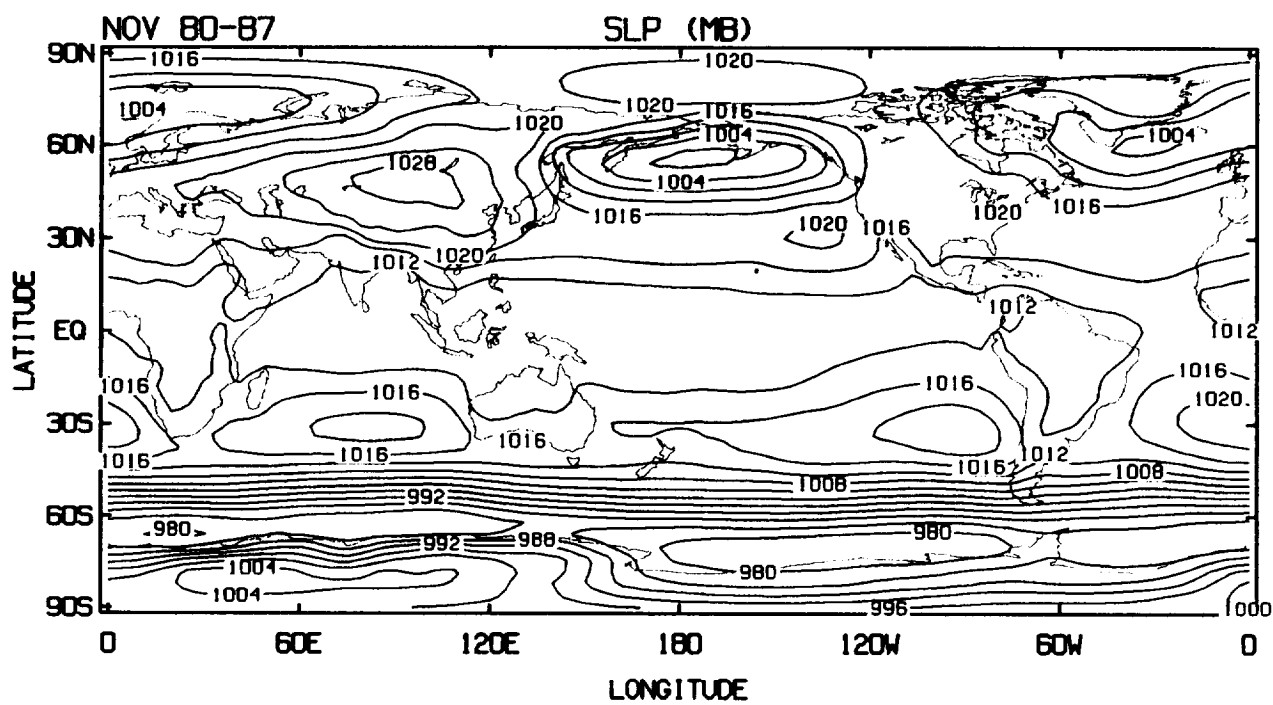


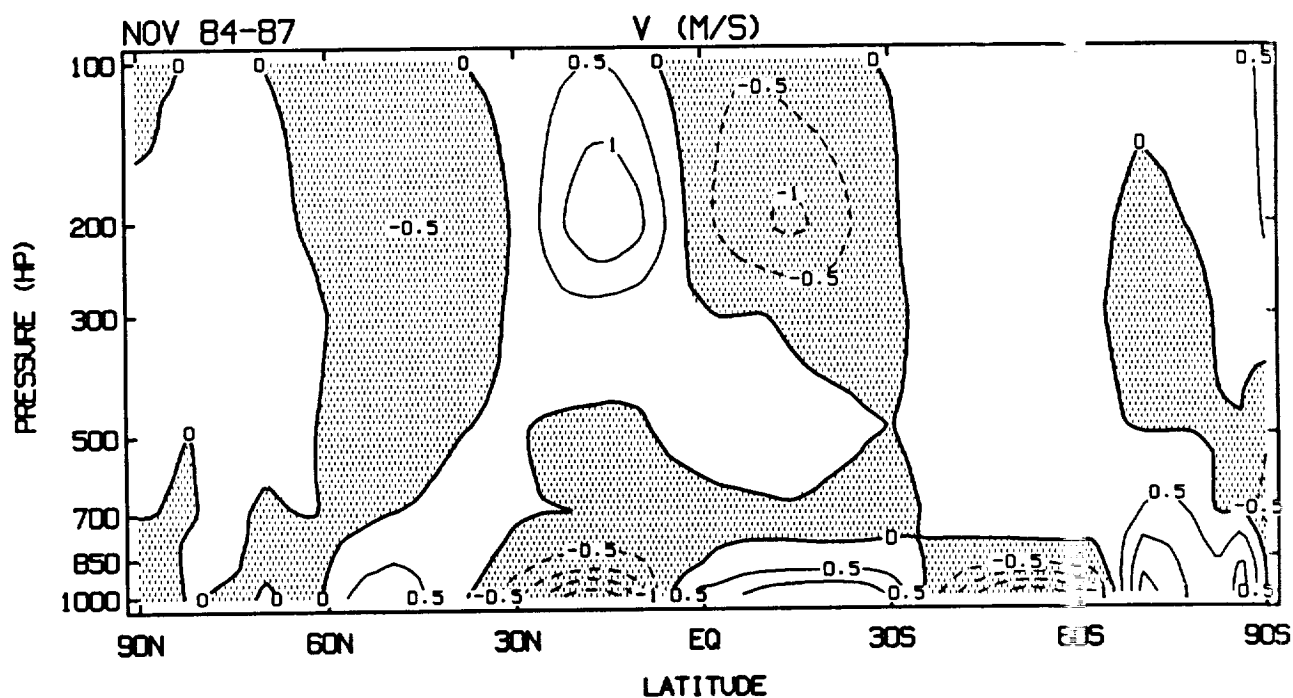
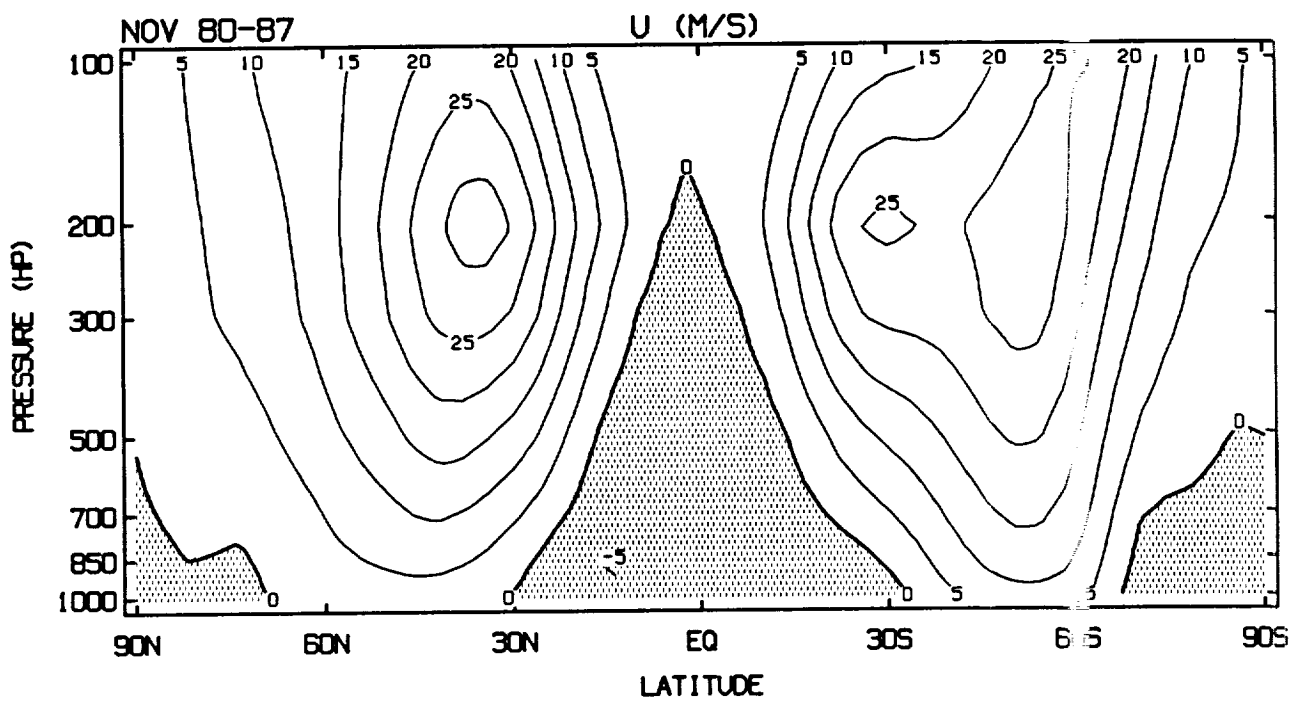


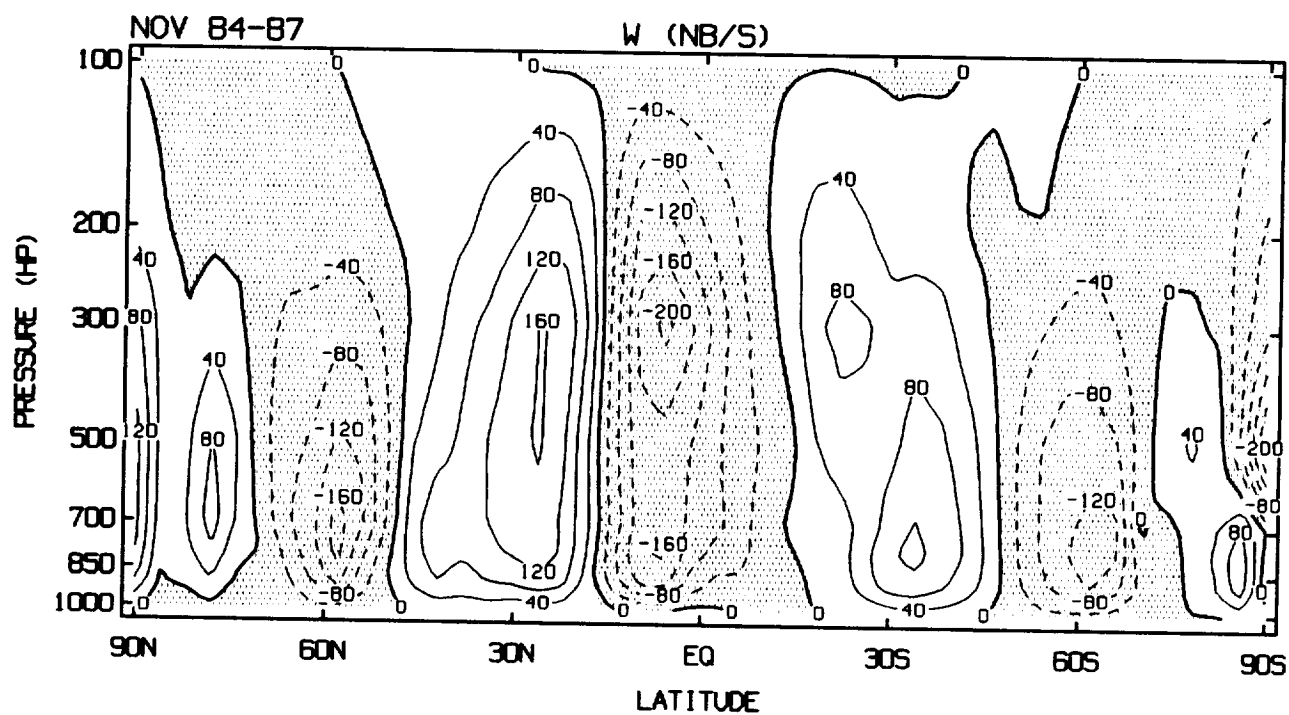
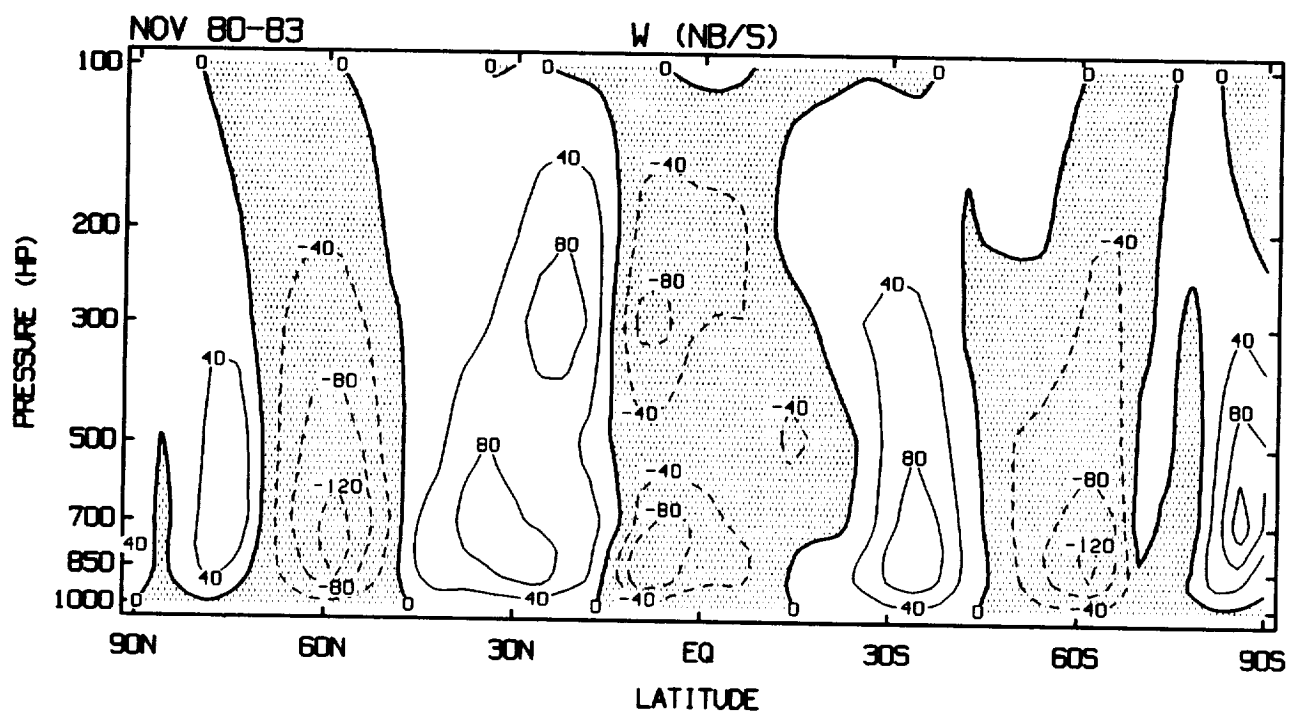


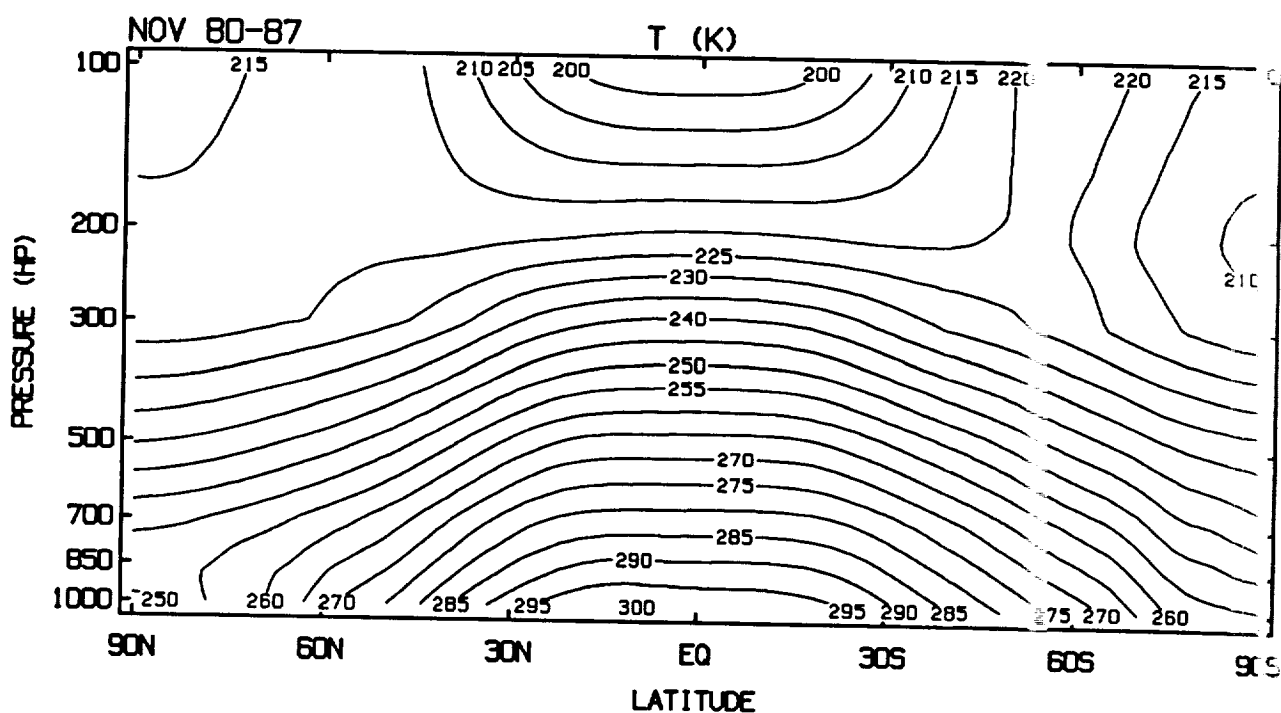
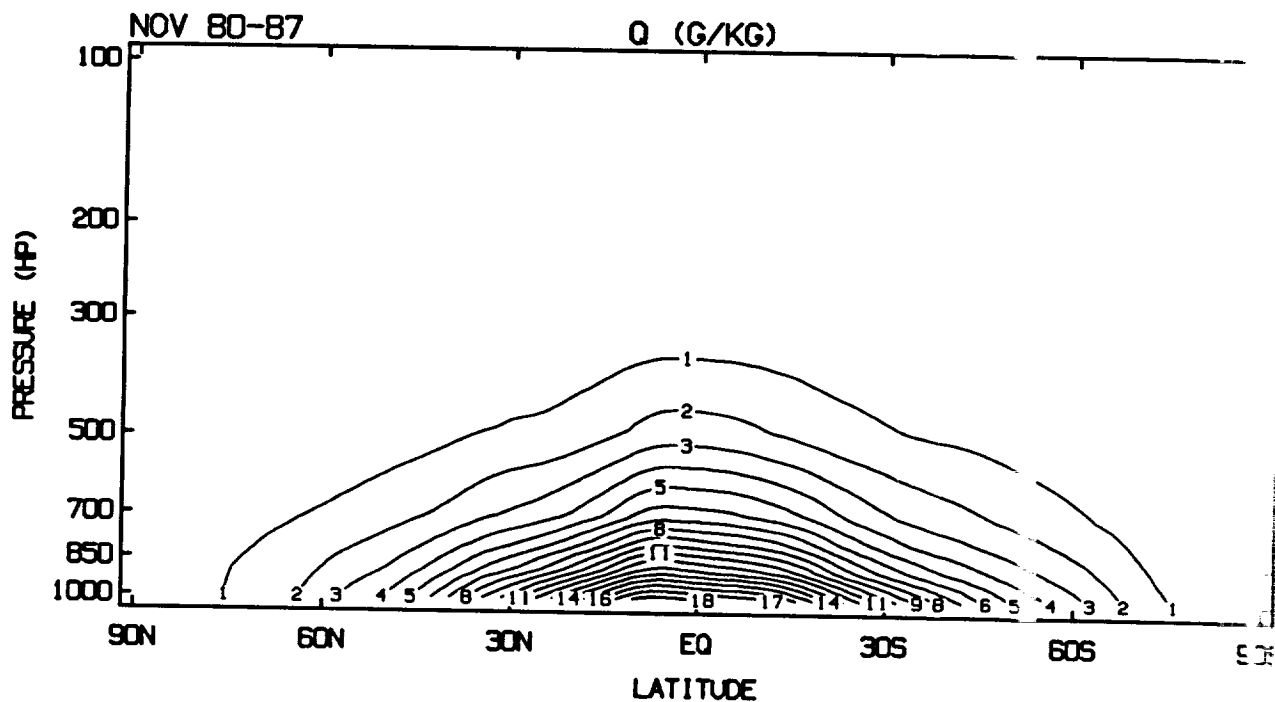




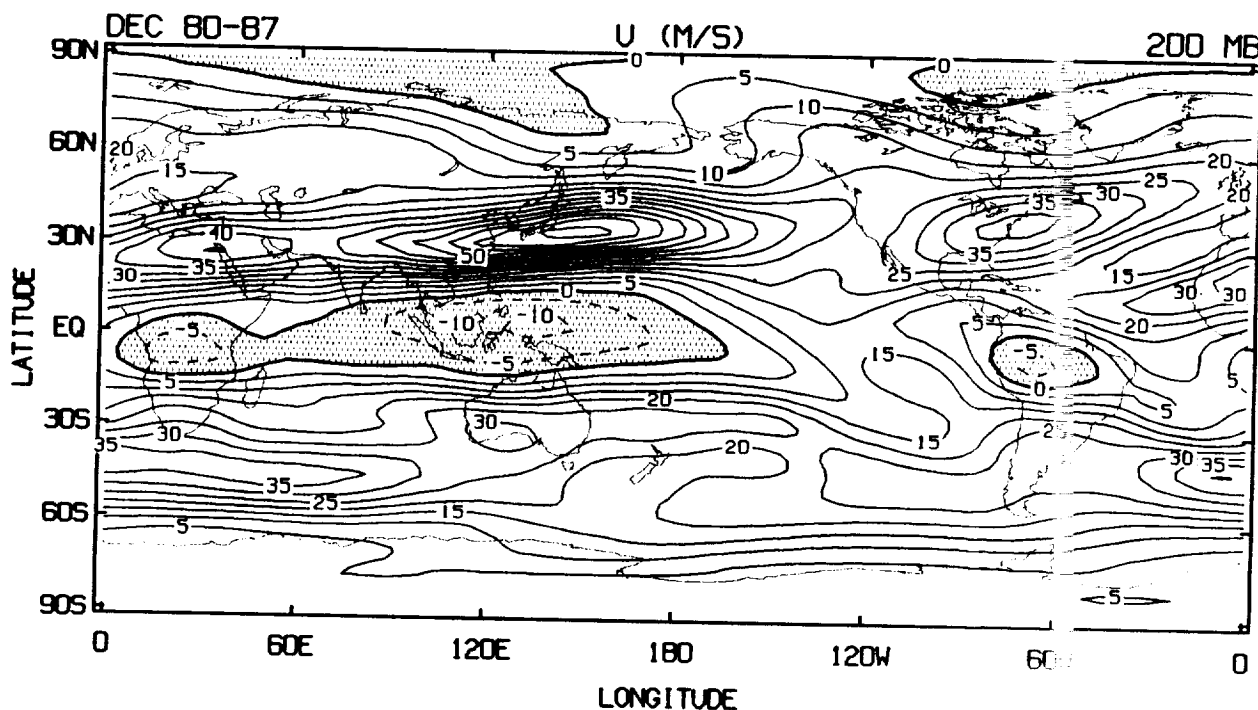
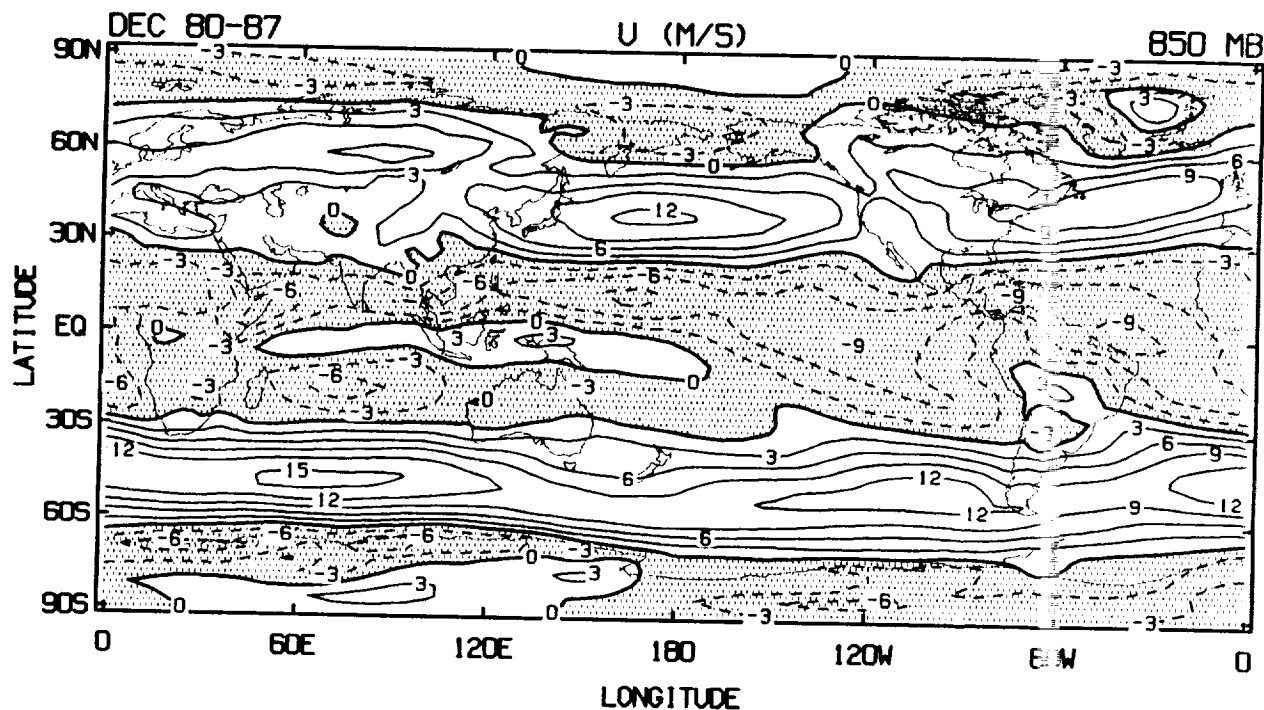


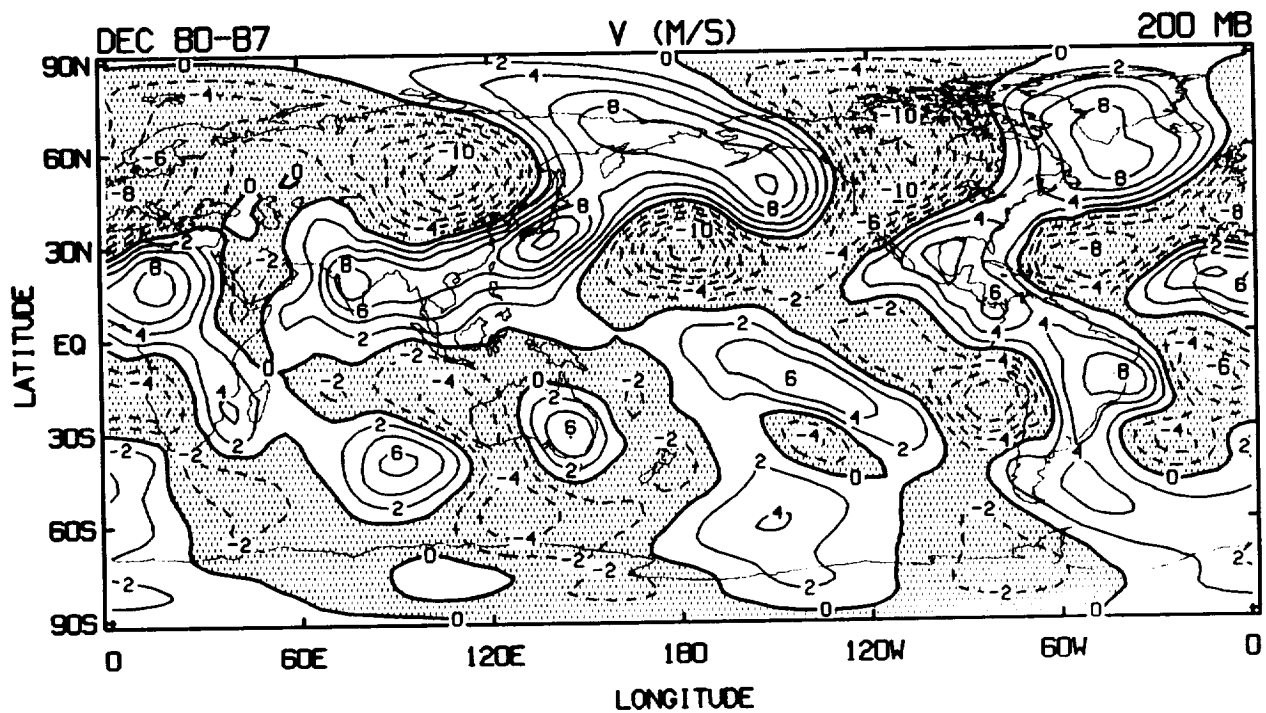
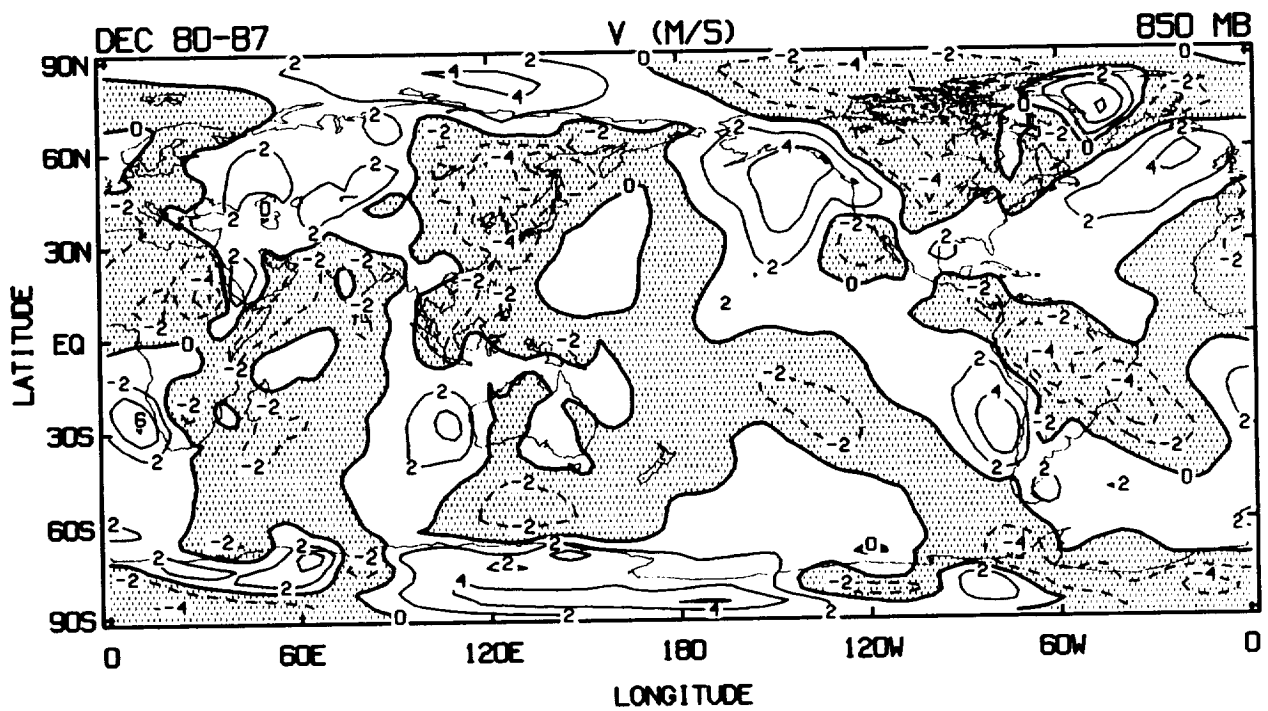


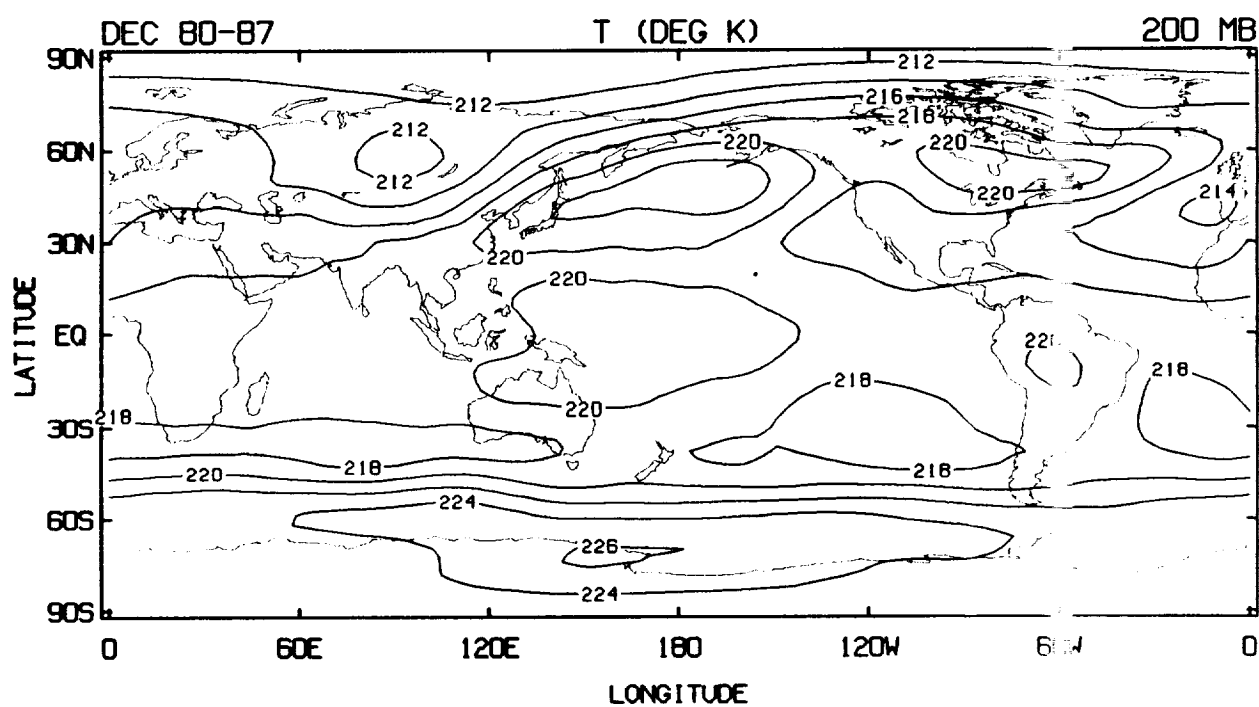
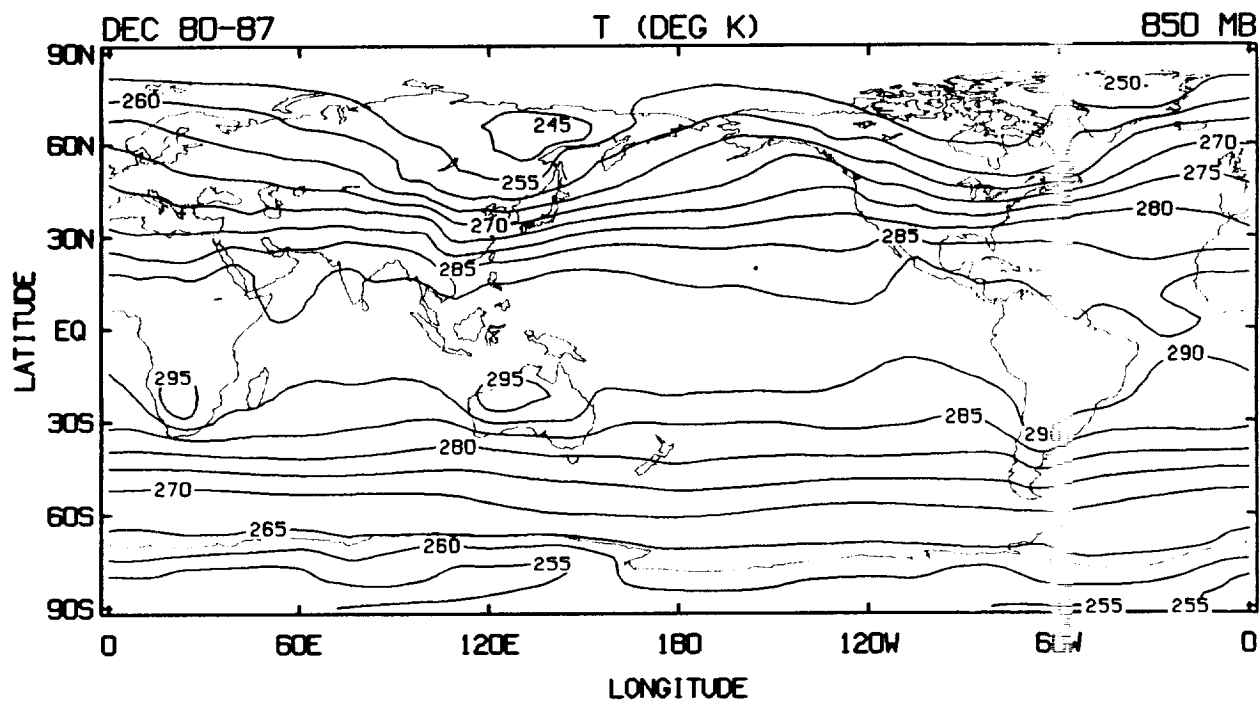


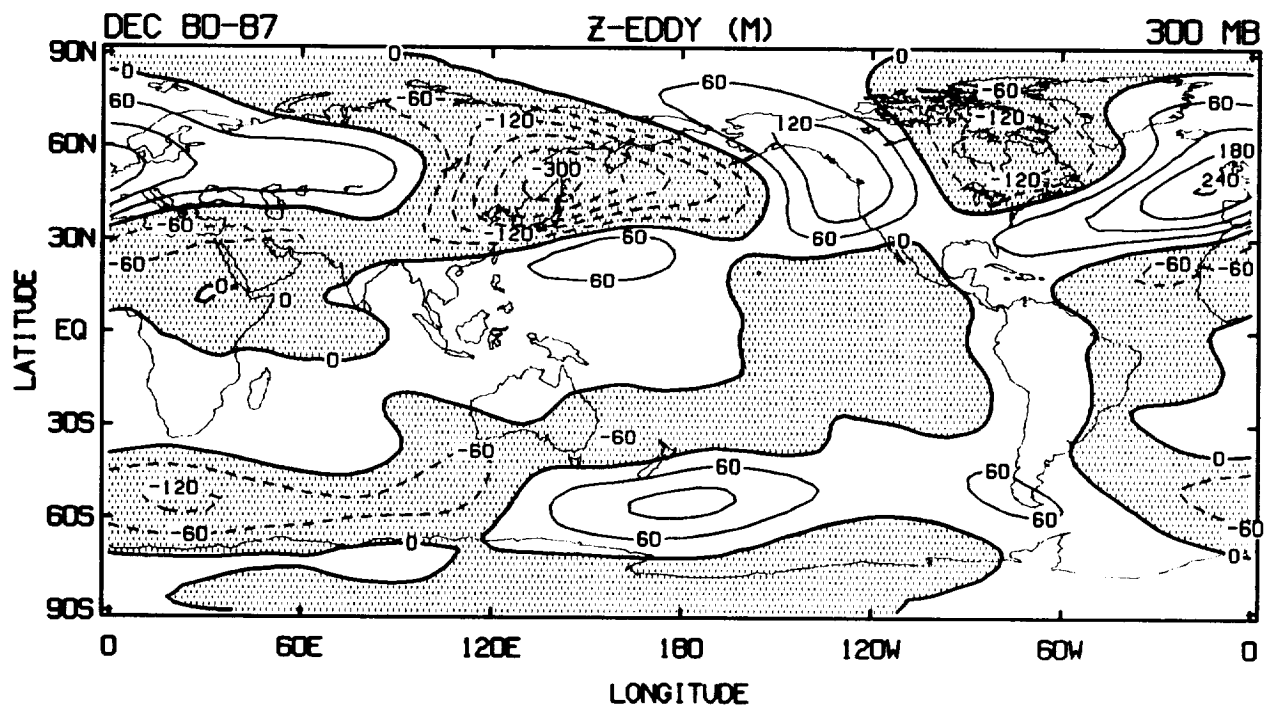
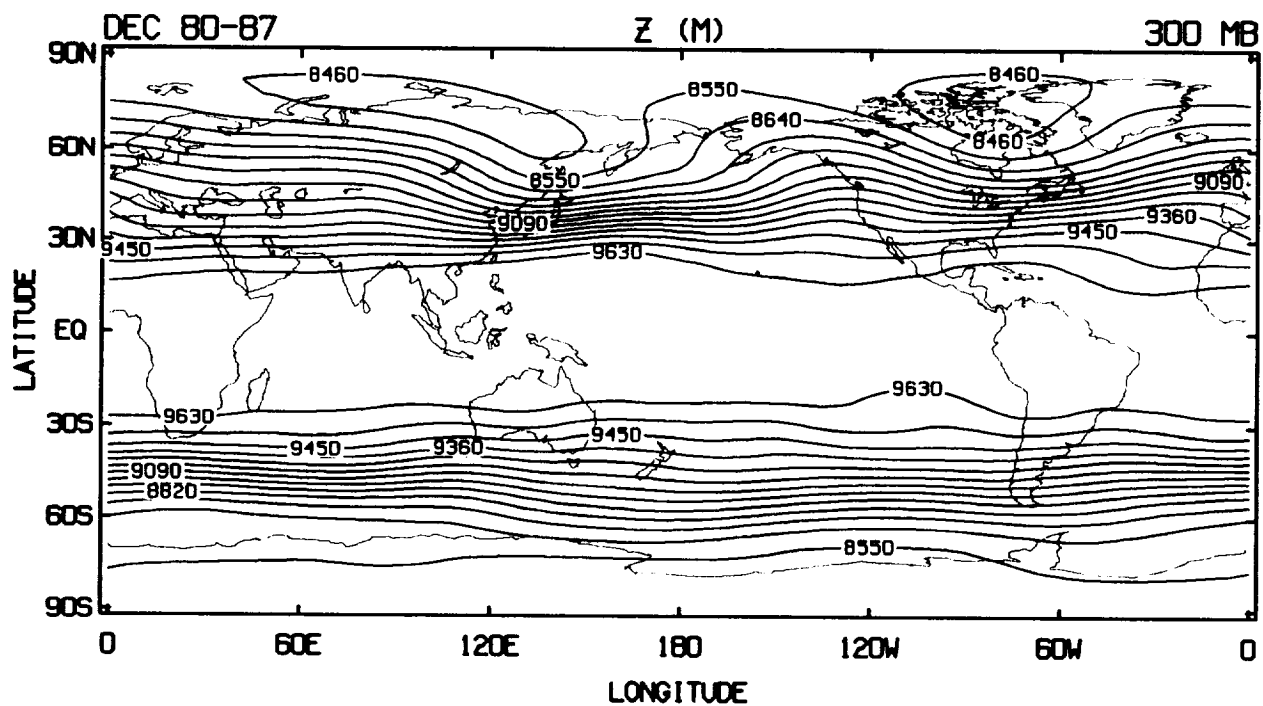


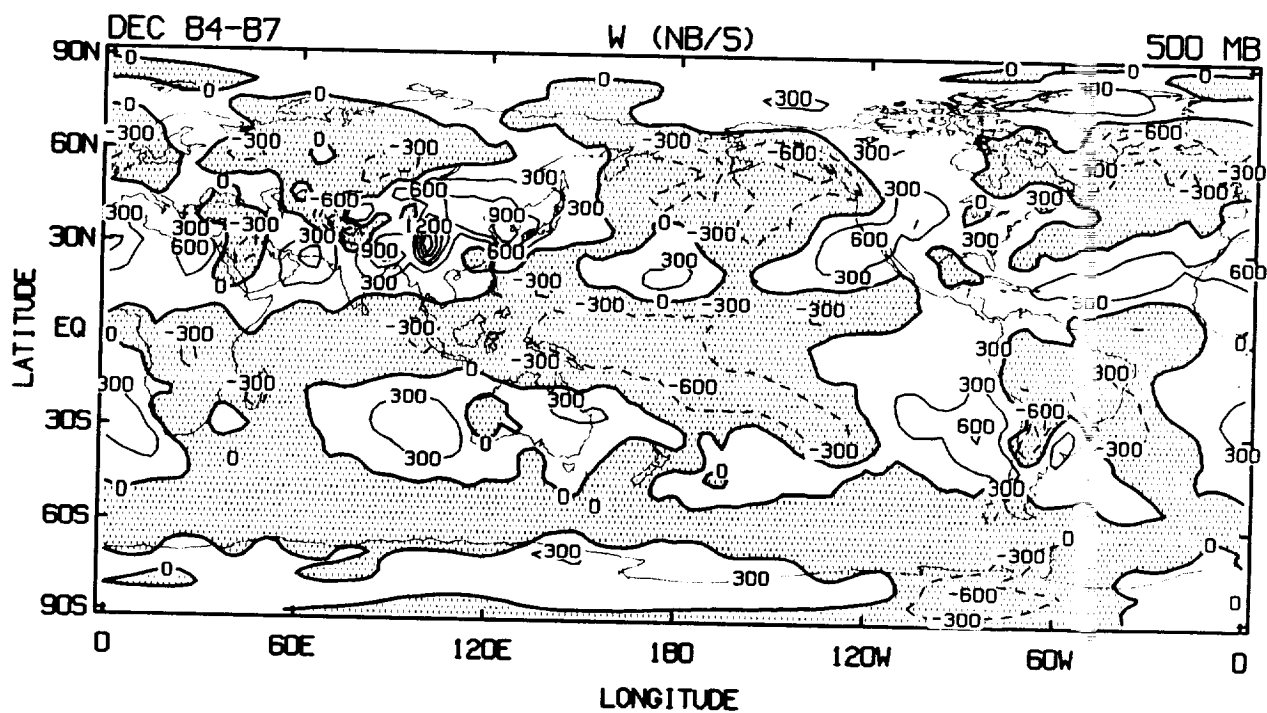
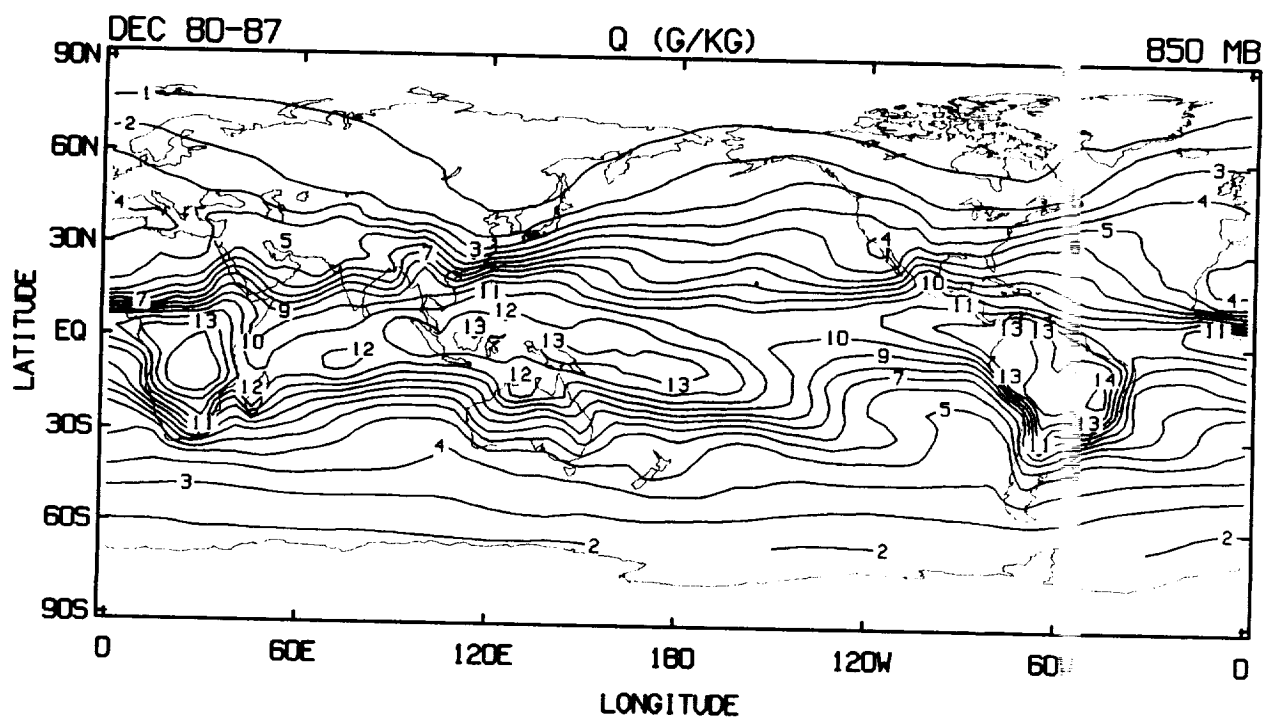
DECEMBER

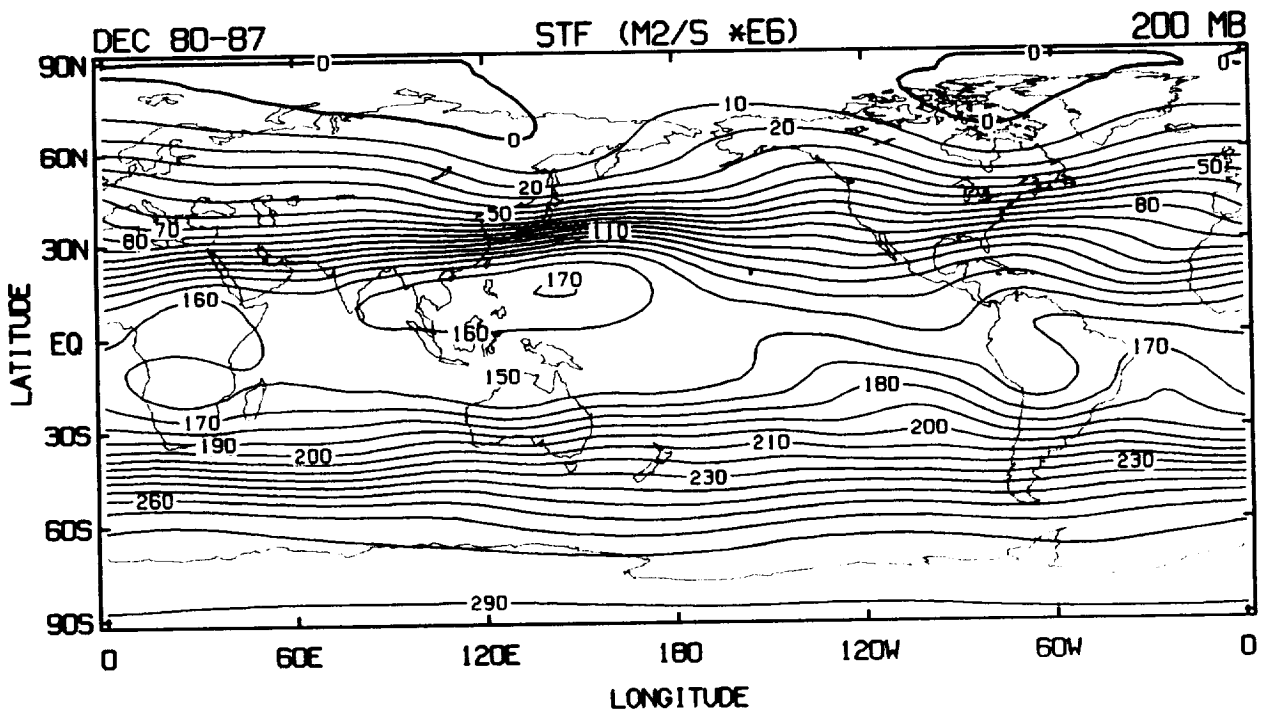
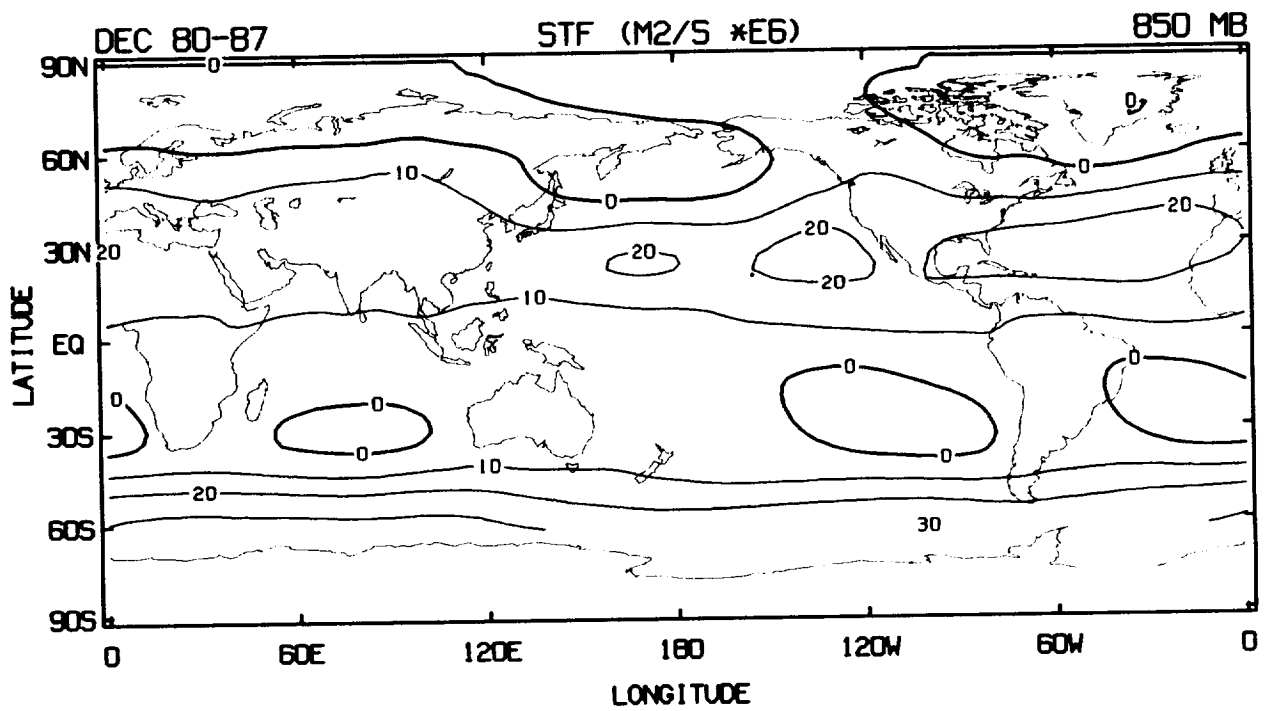


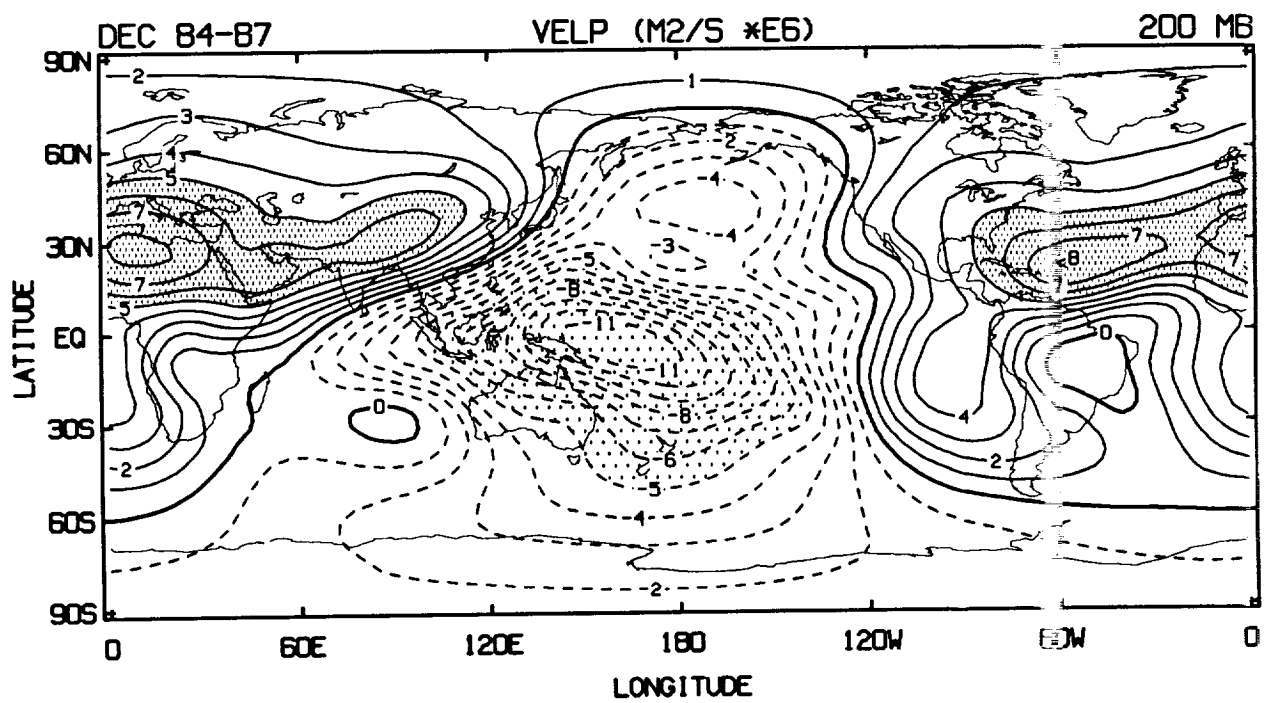
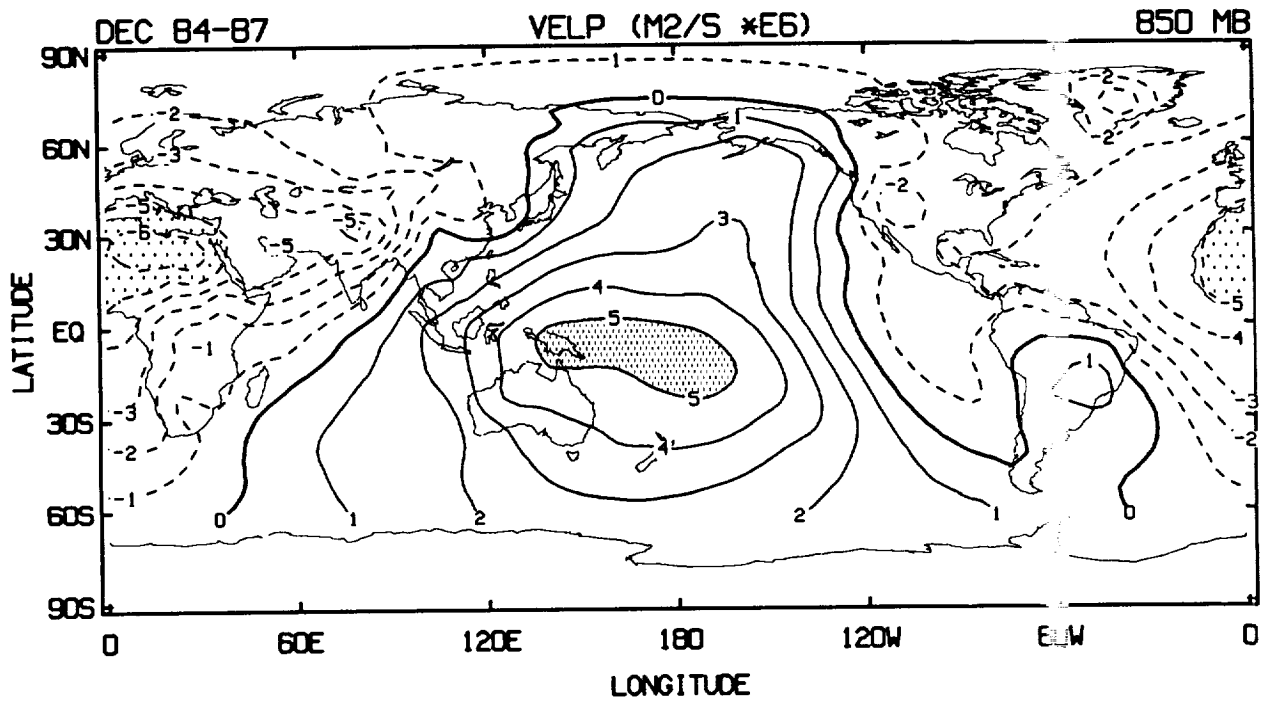


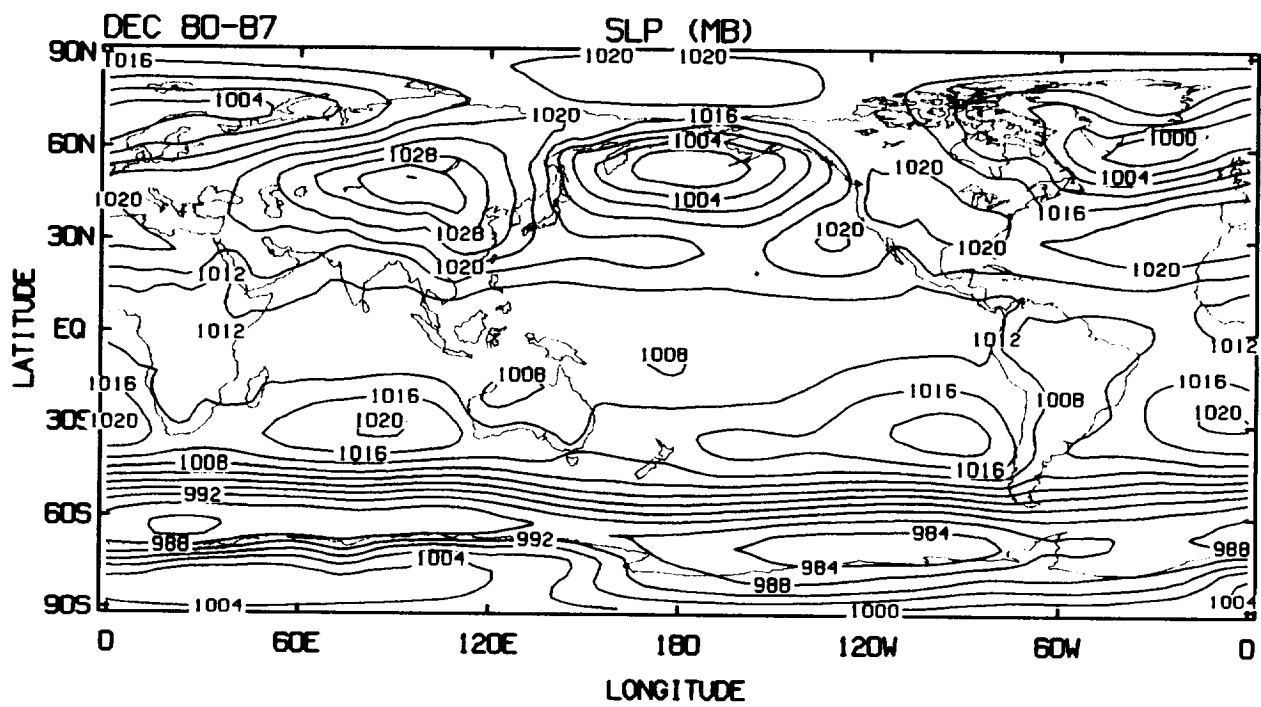


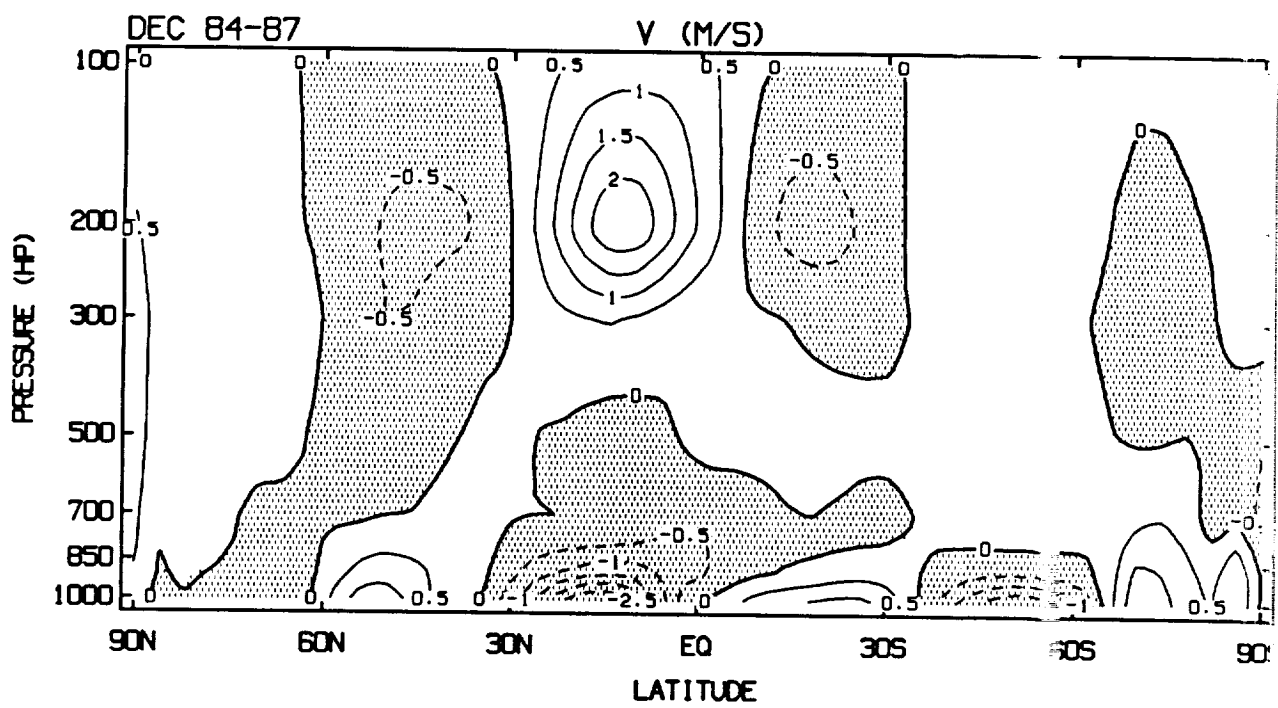
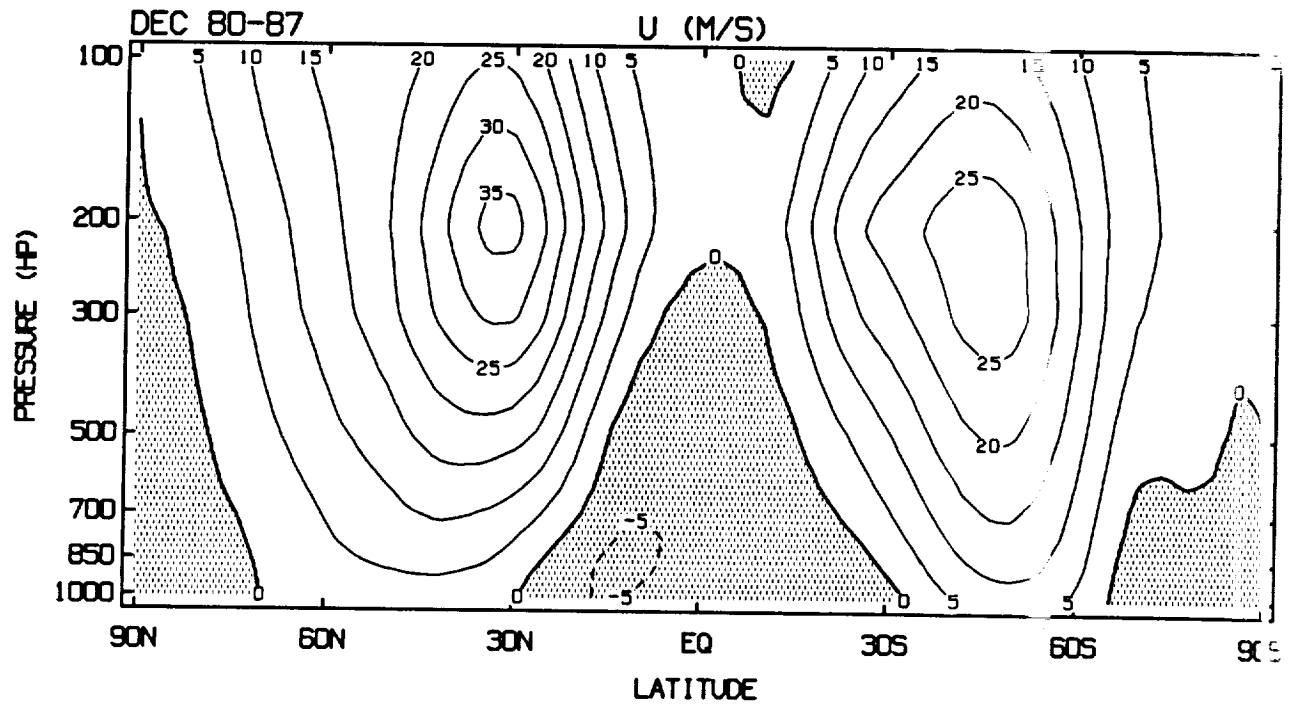


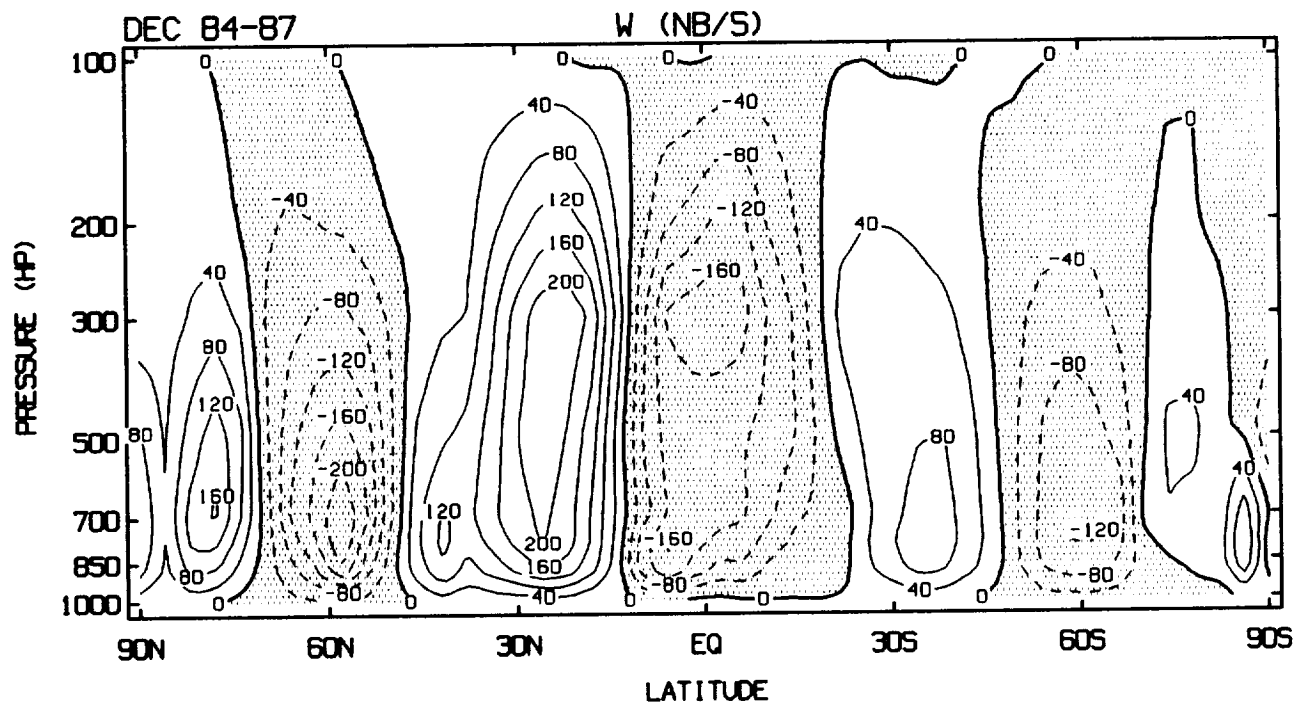
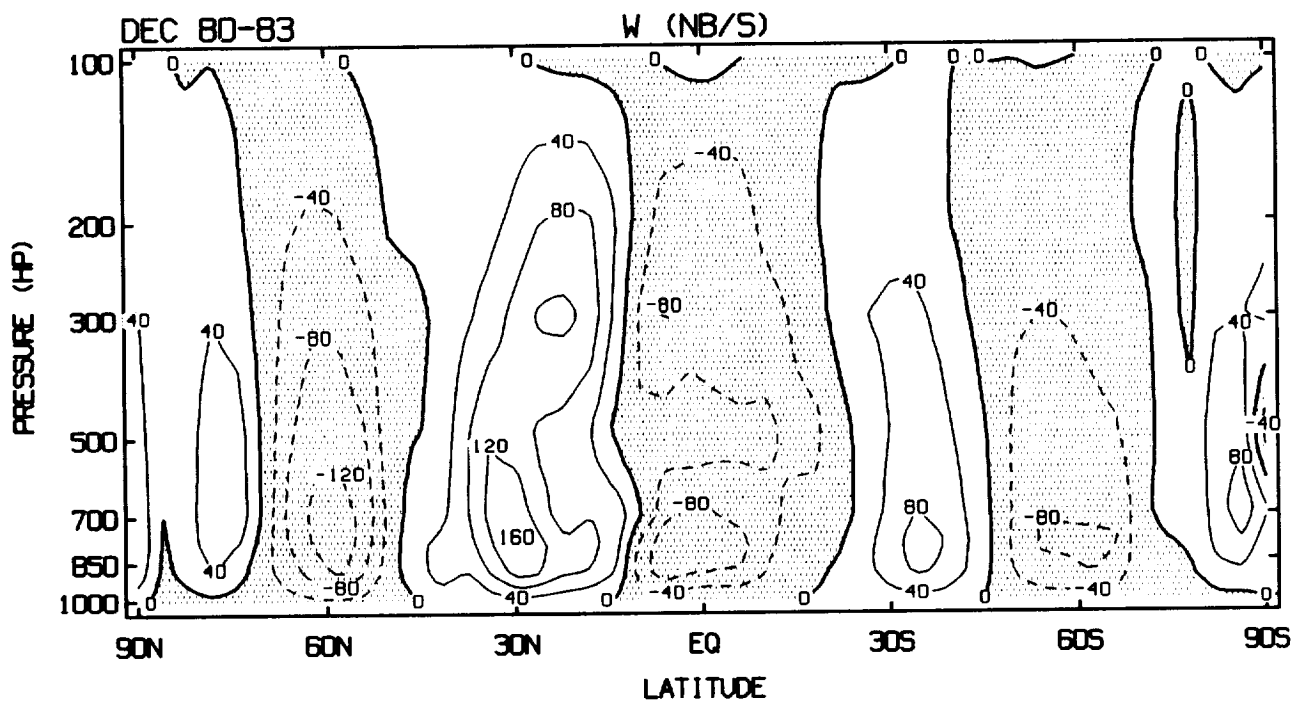


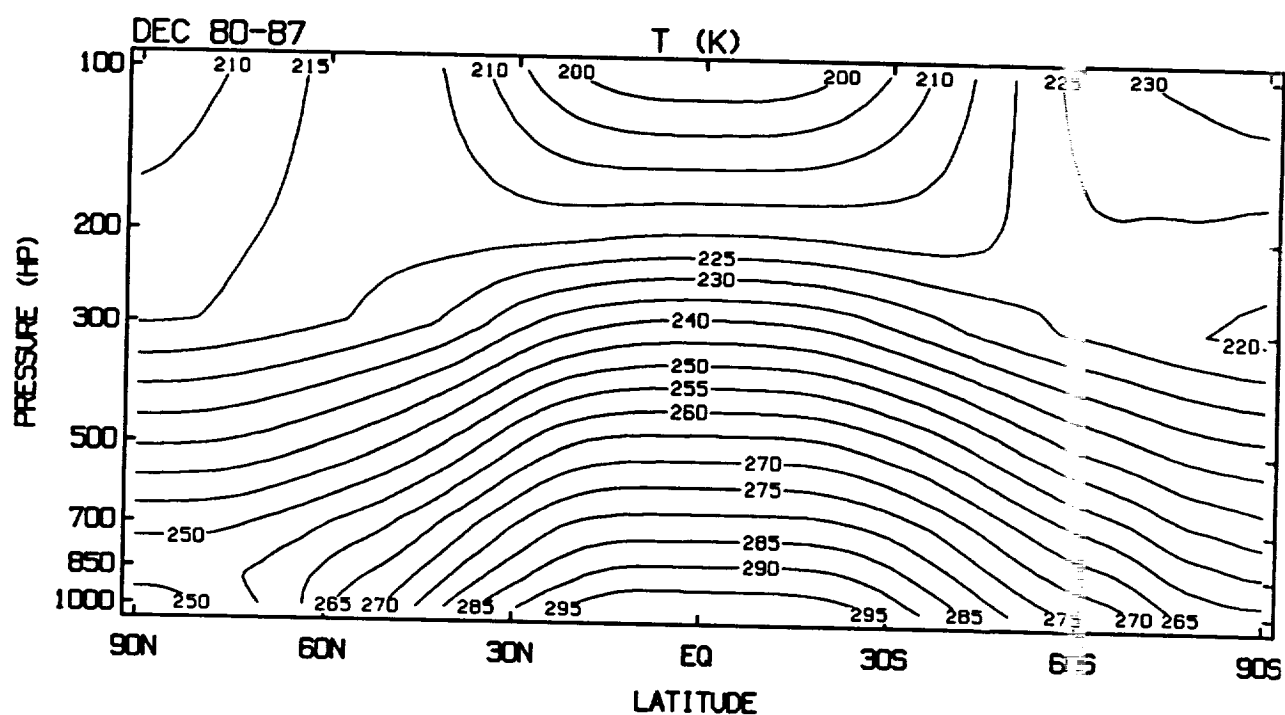
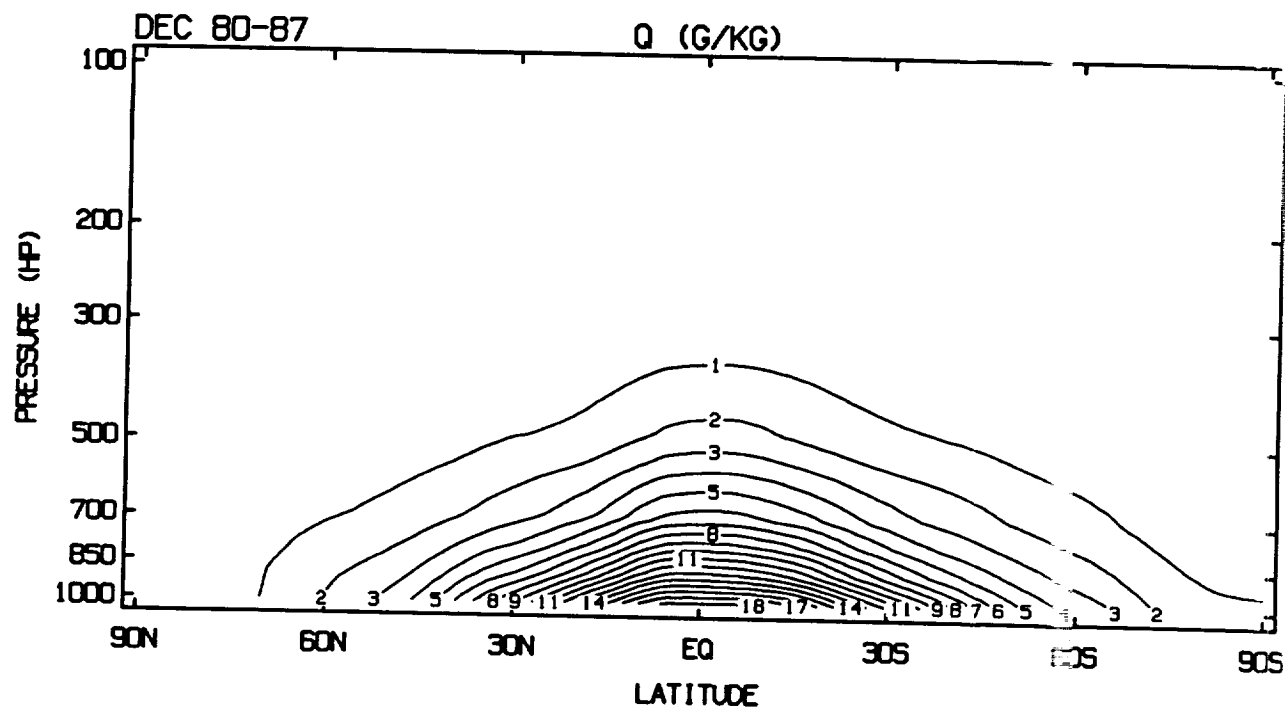




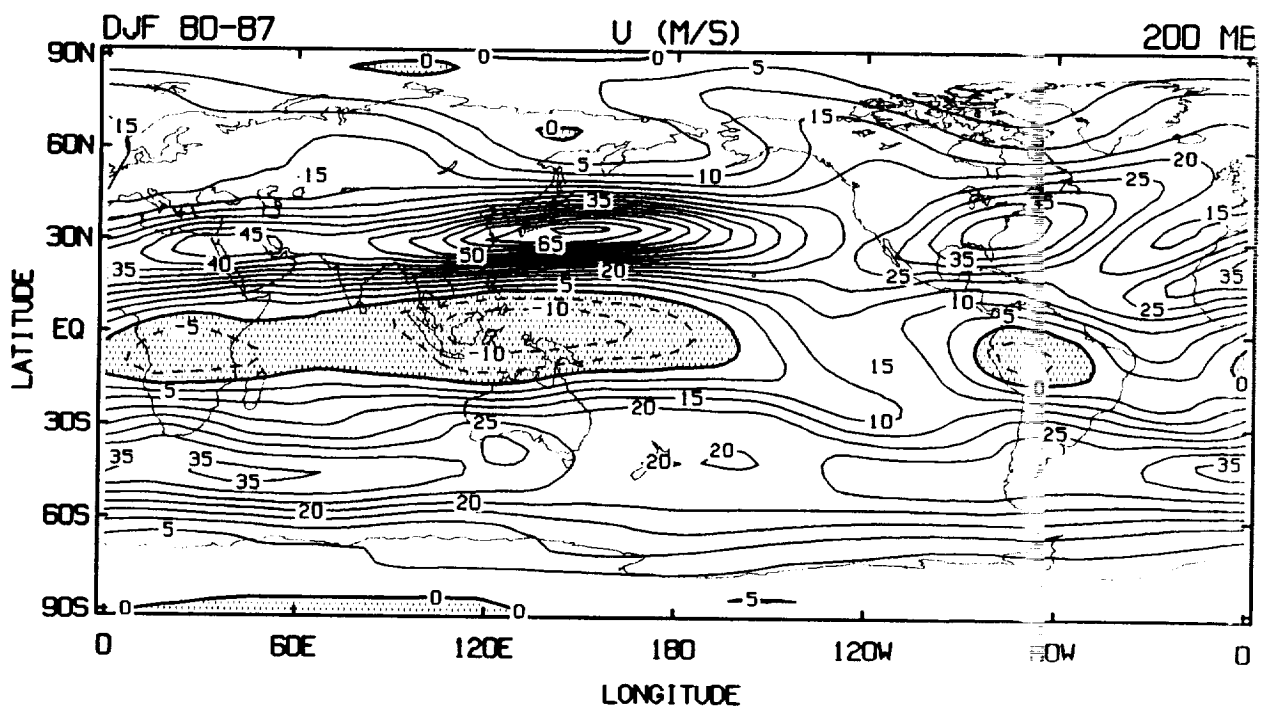
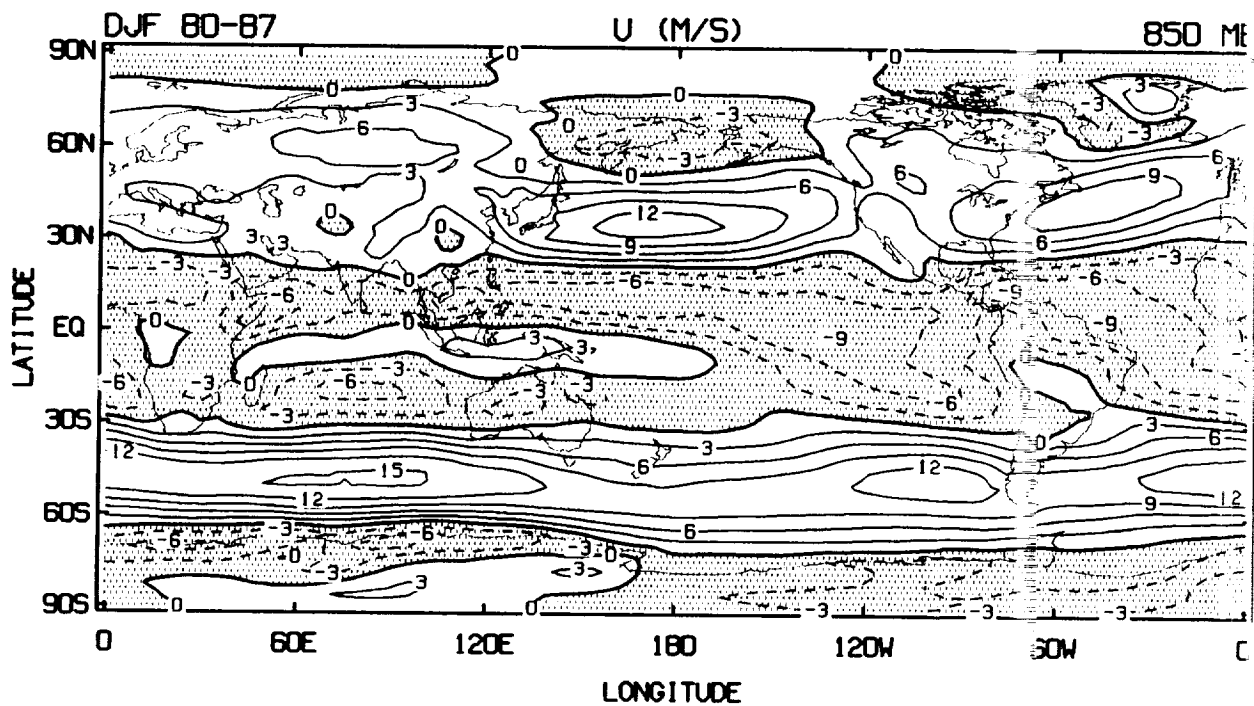


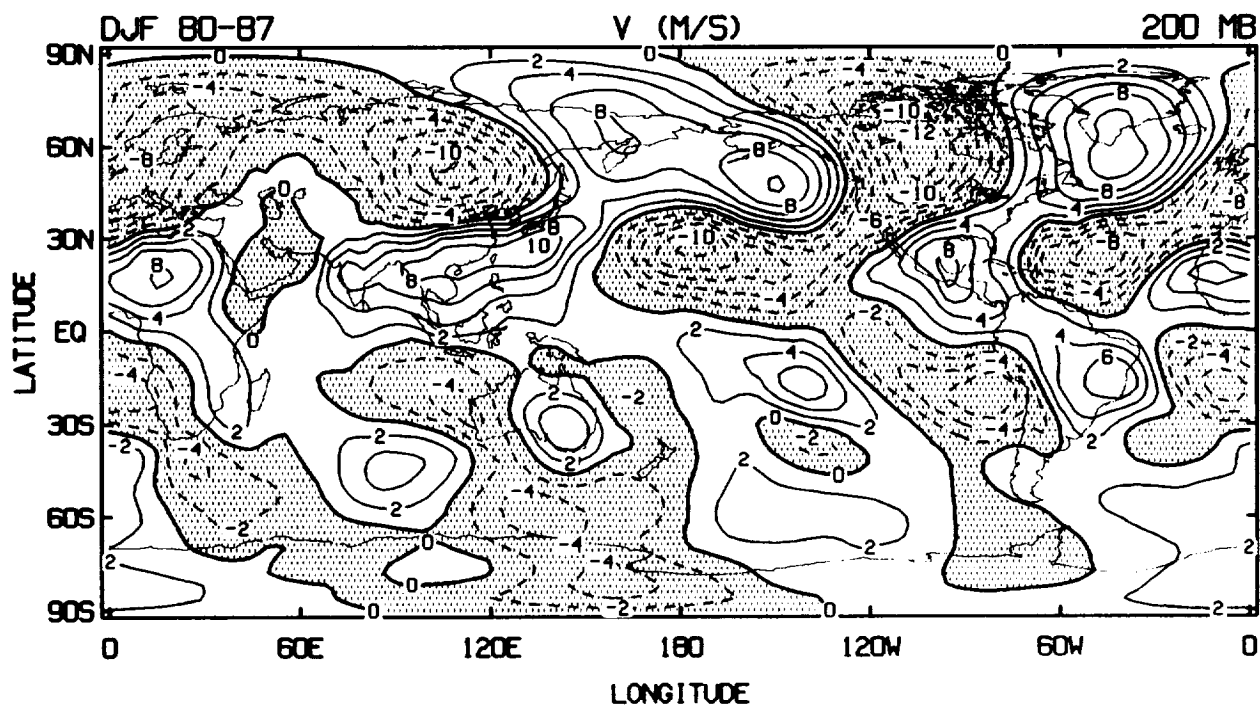
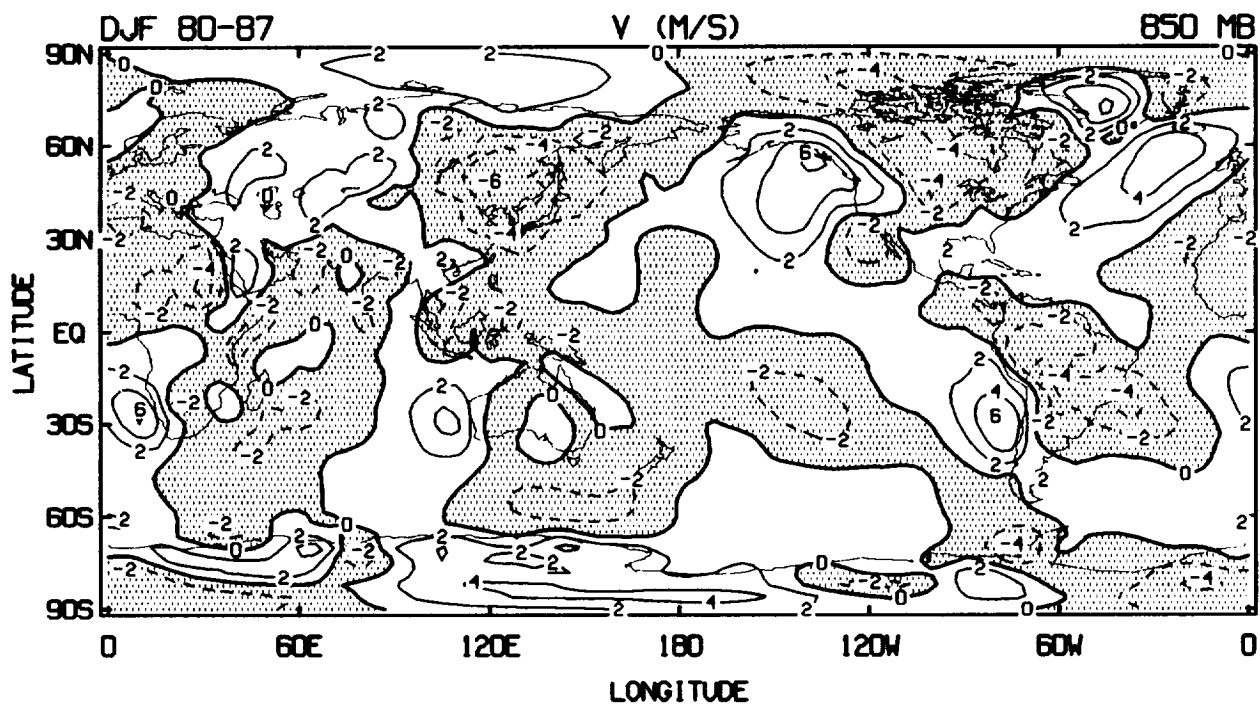


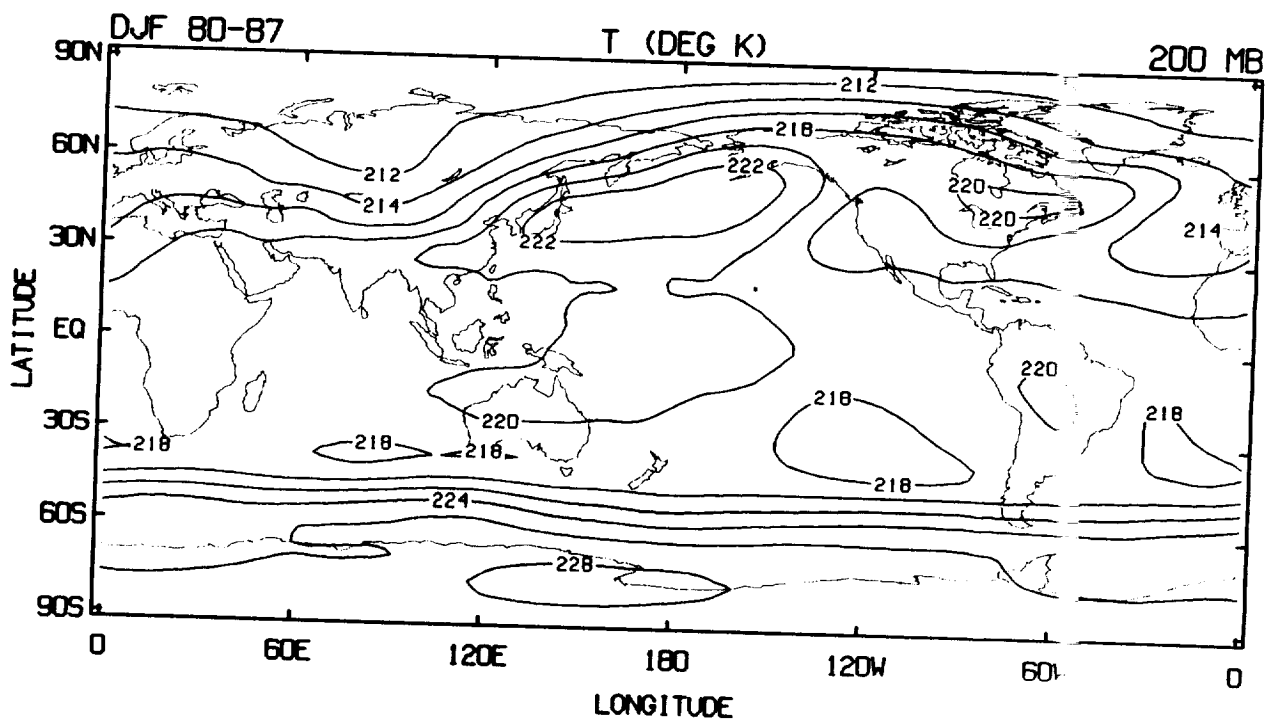
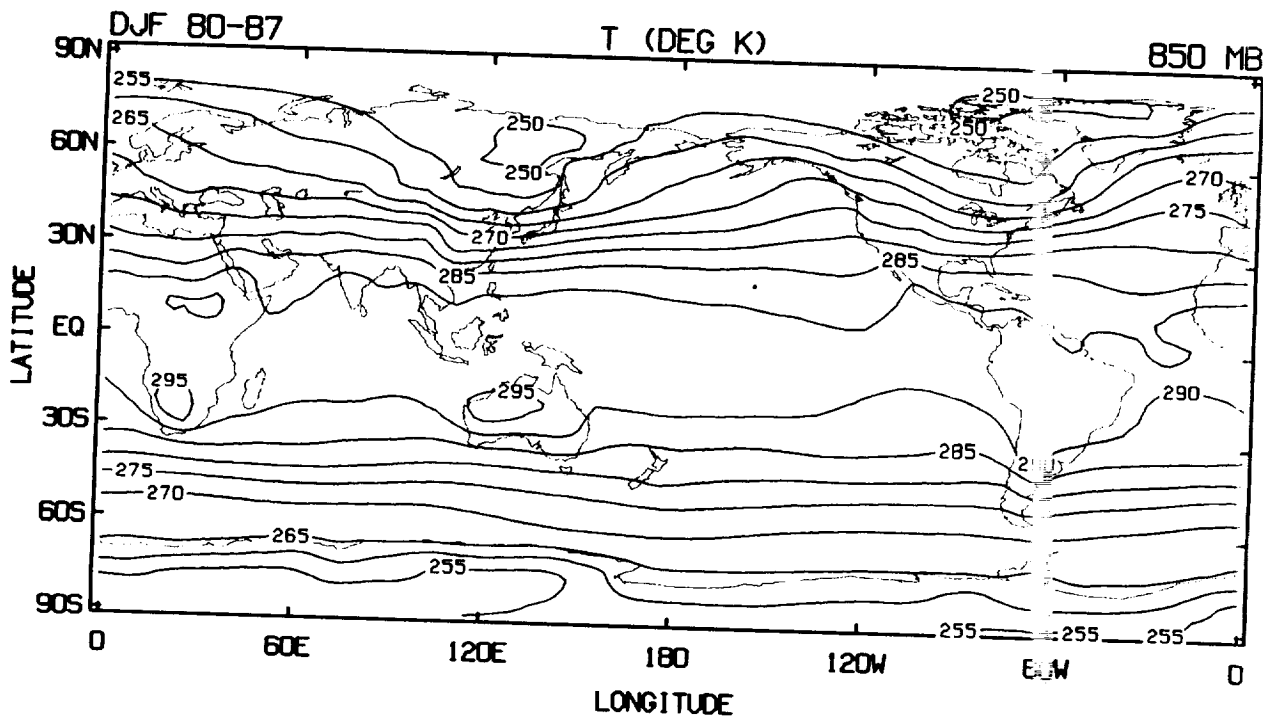


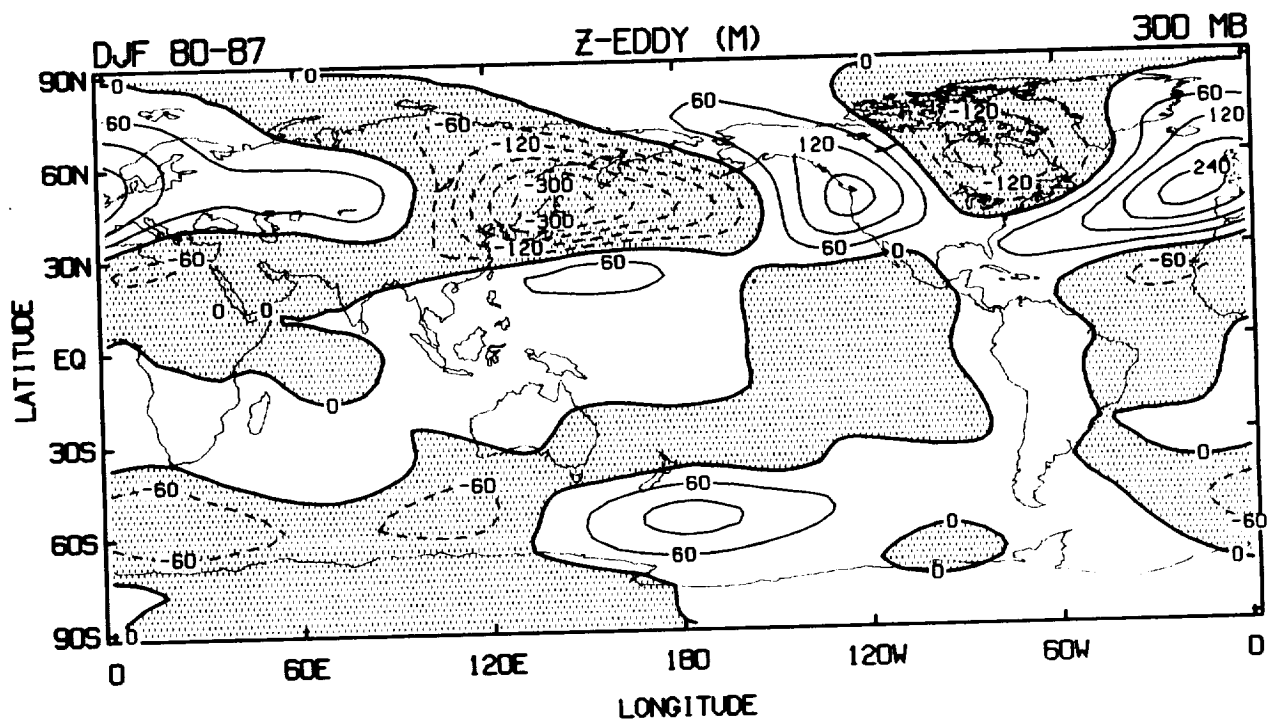
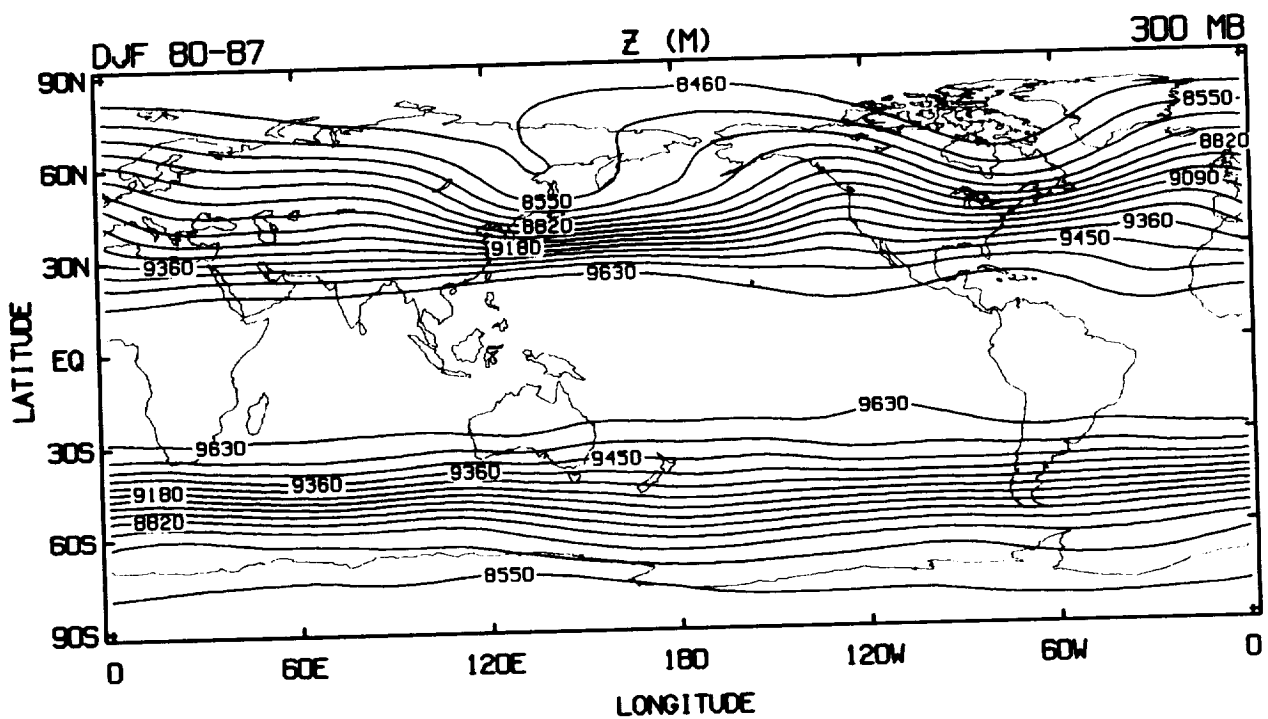


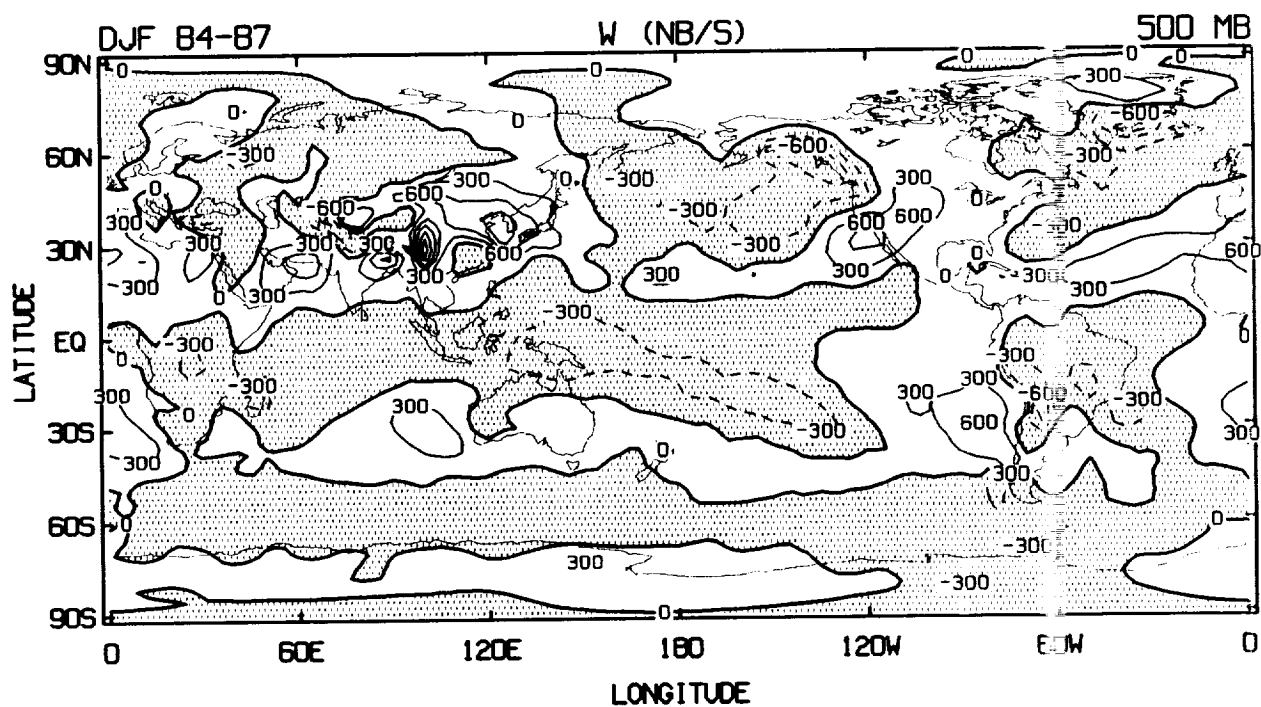
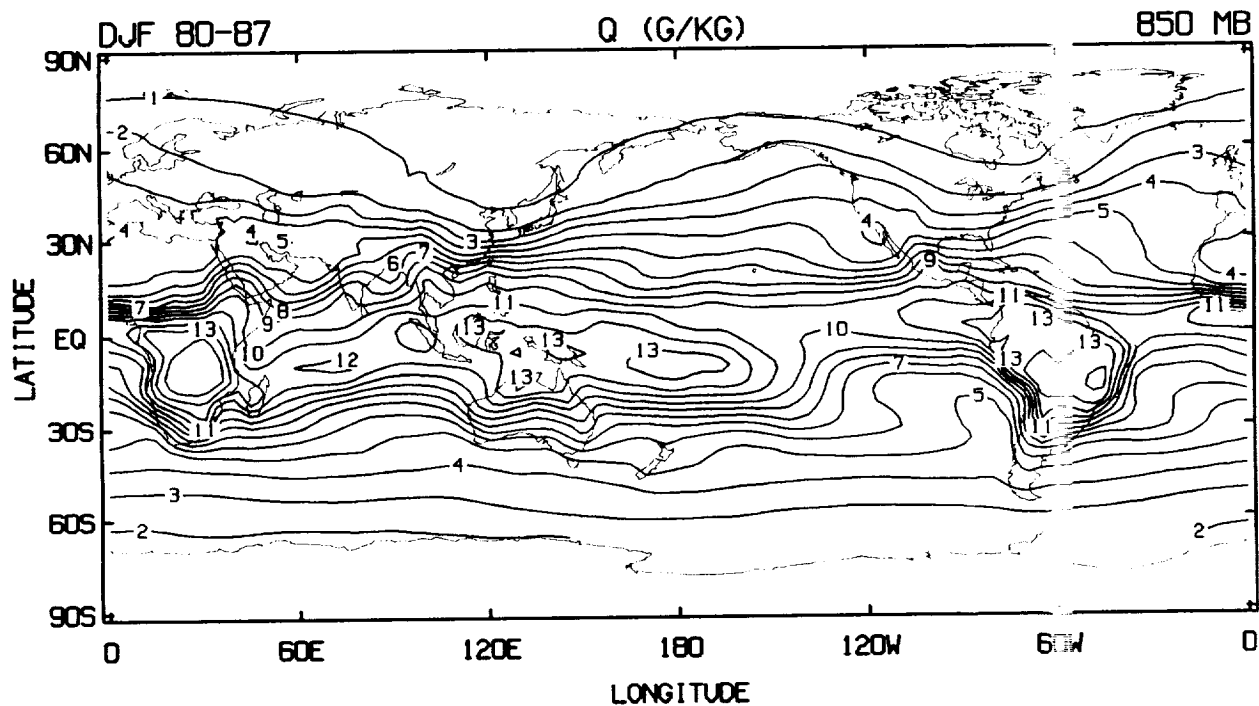
**DECEMBER
JANUARY
FEBRUARY**

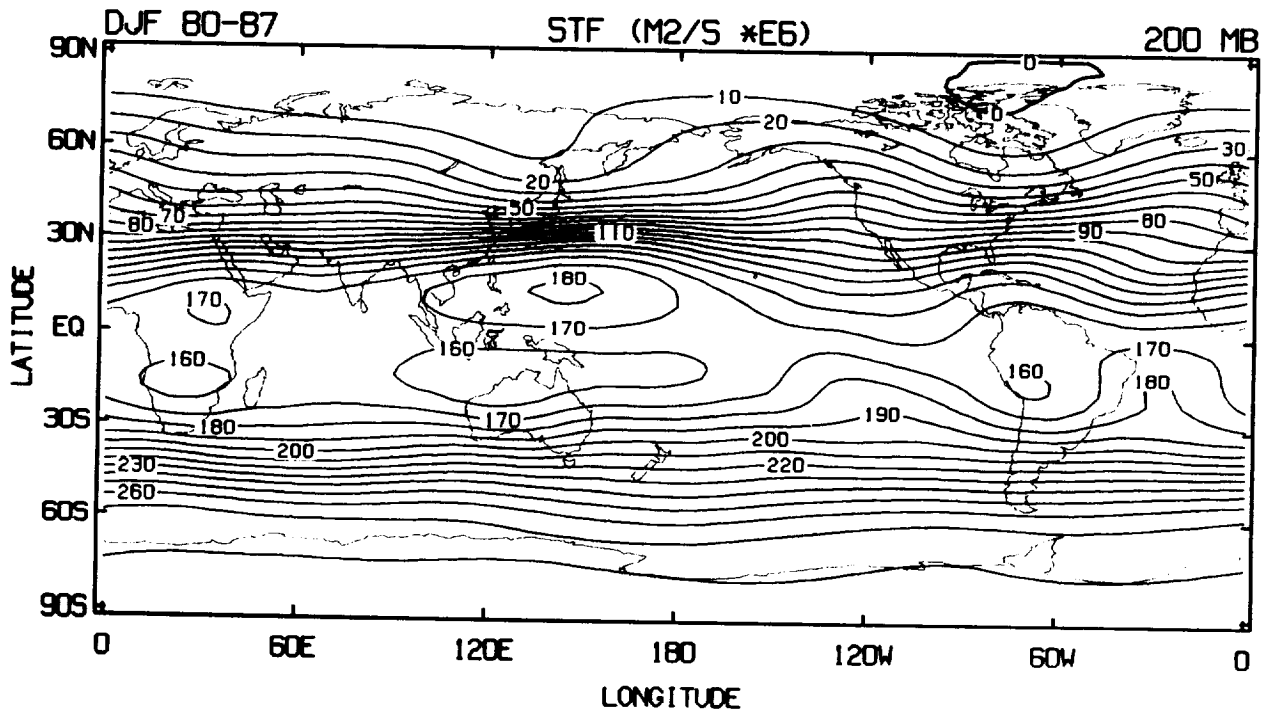
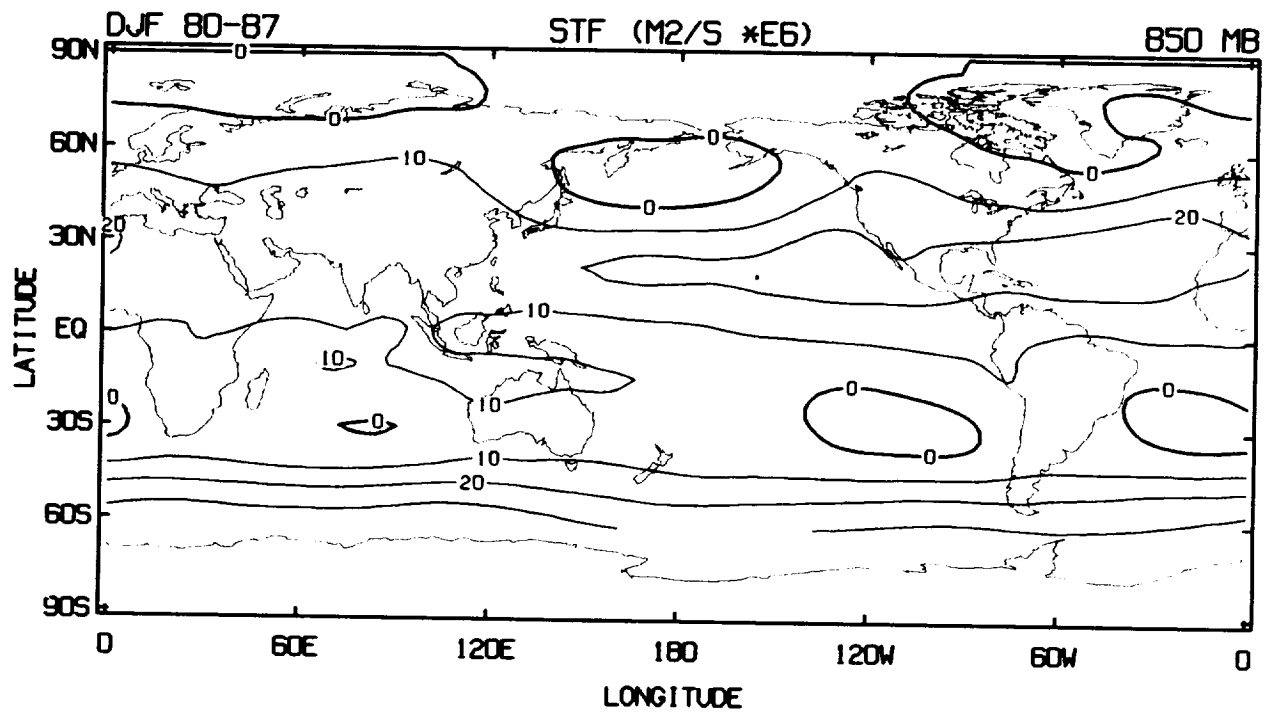


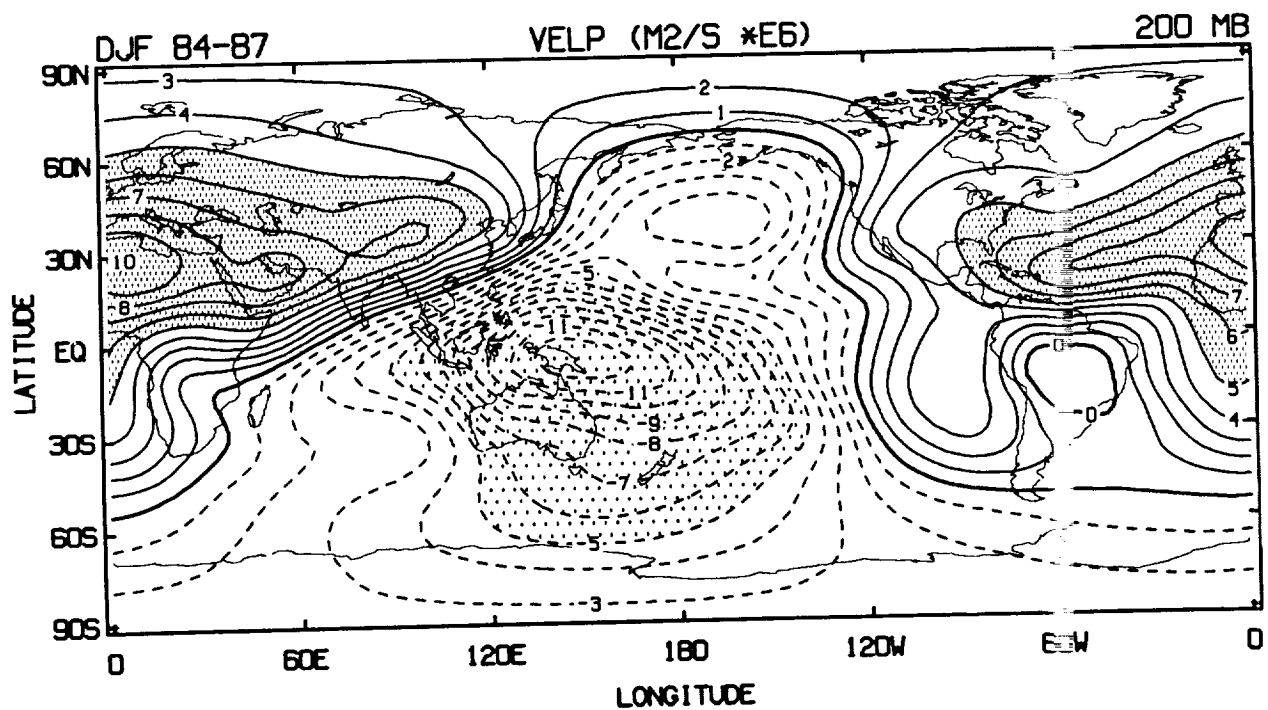
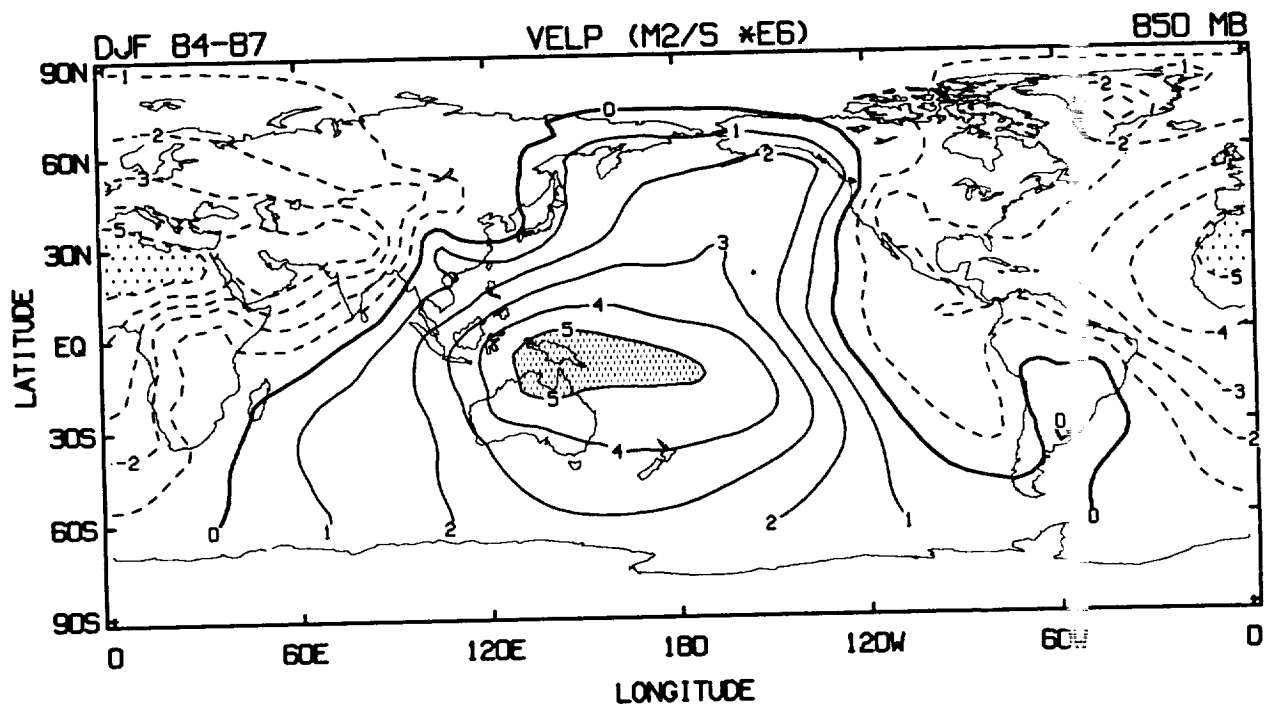


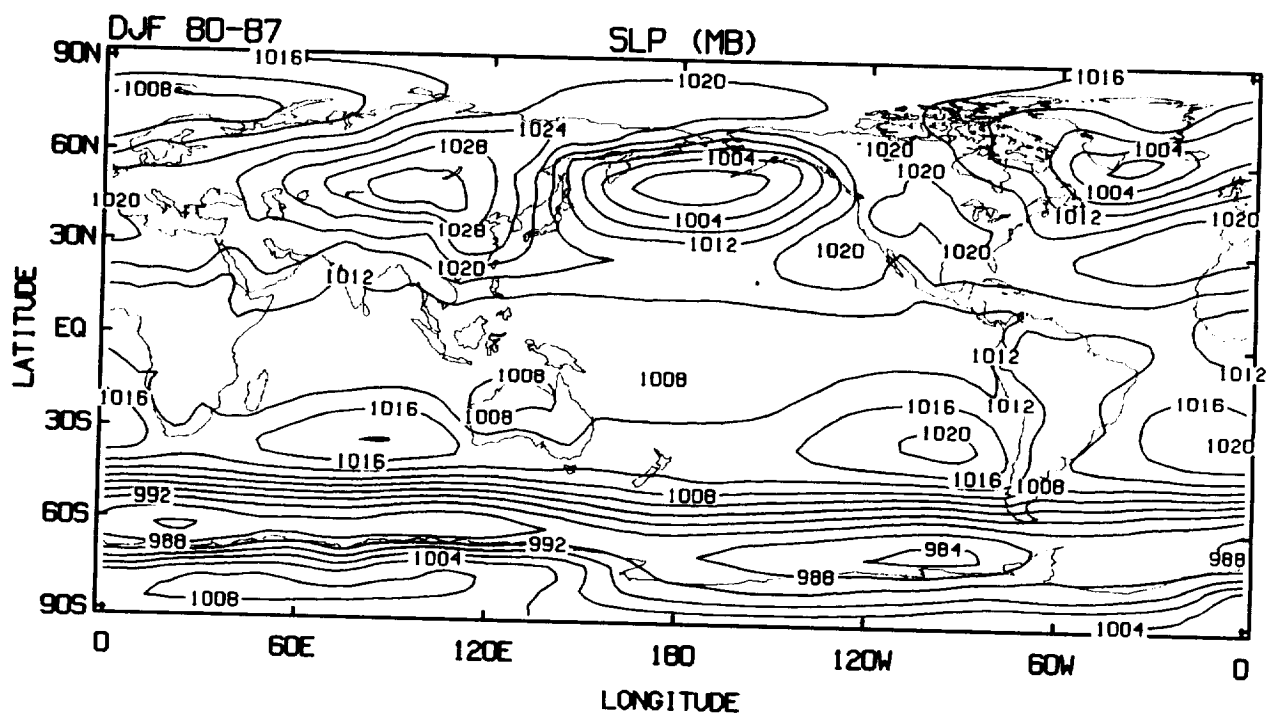


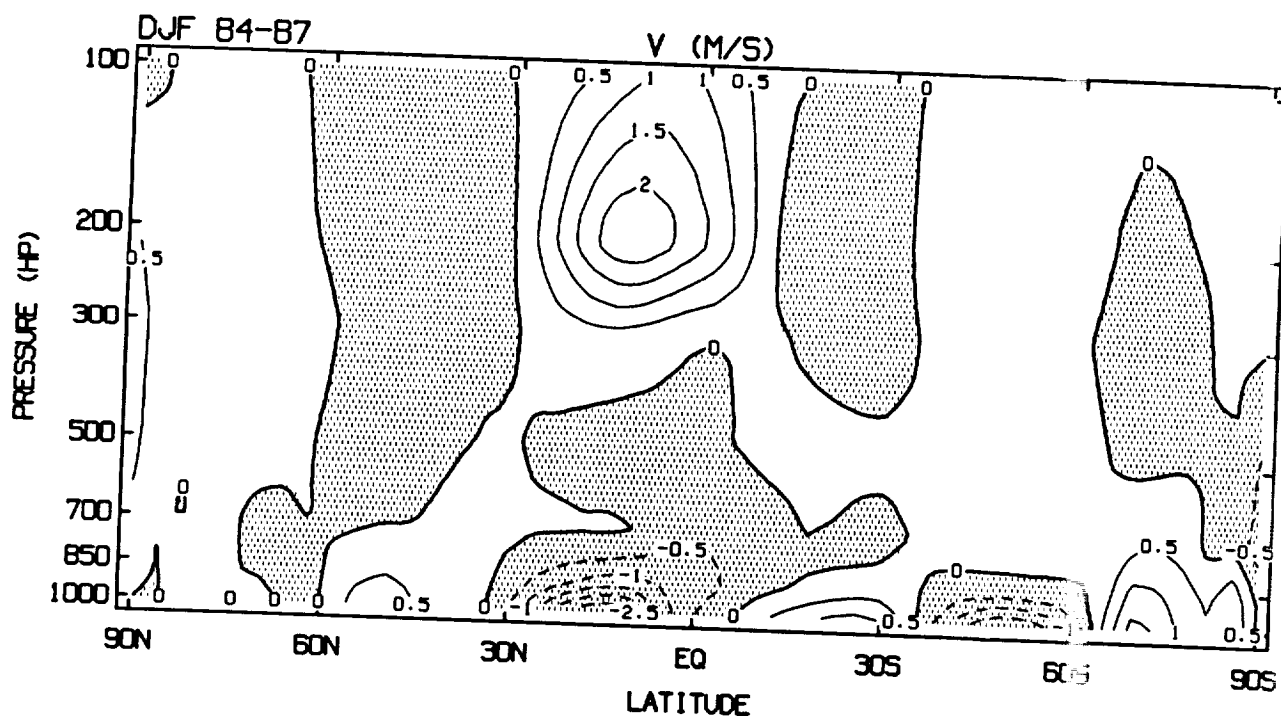
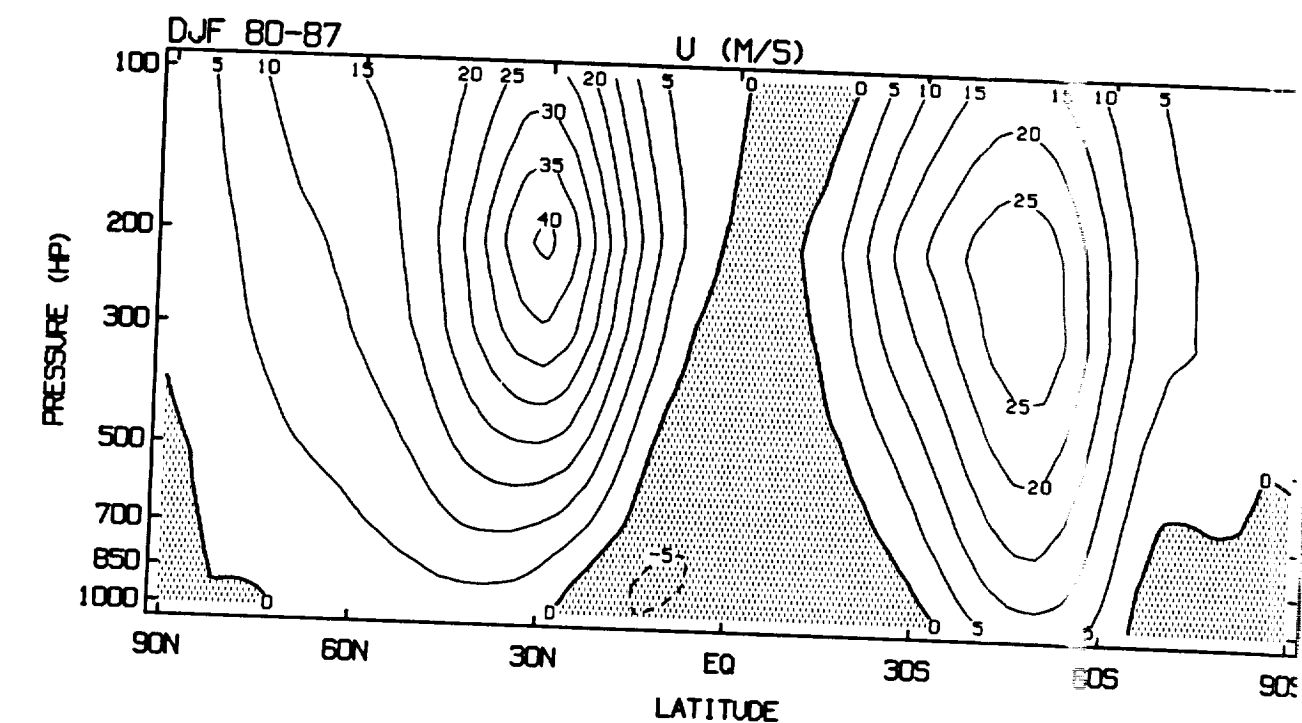


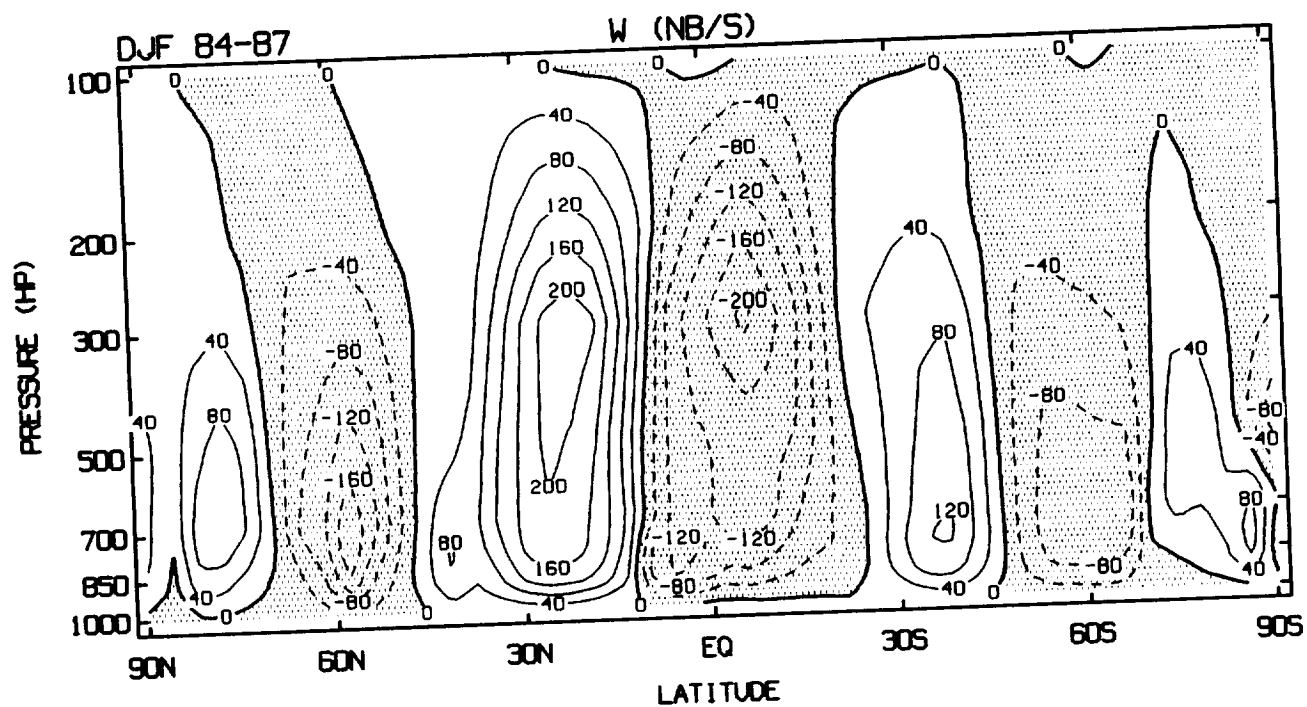
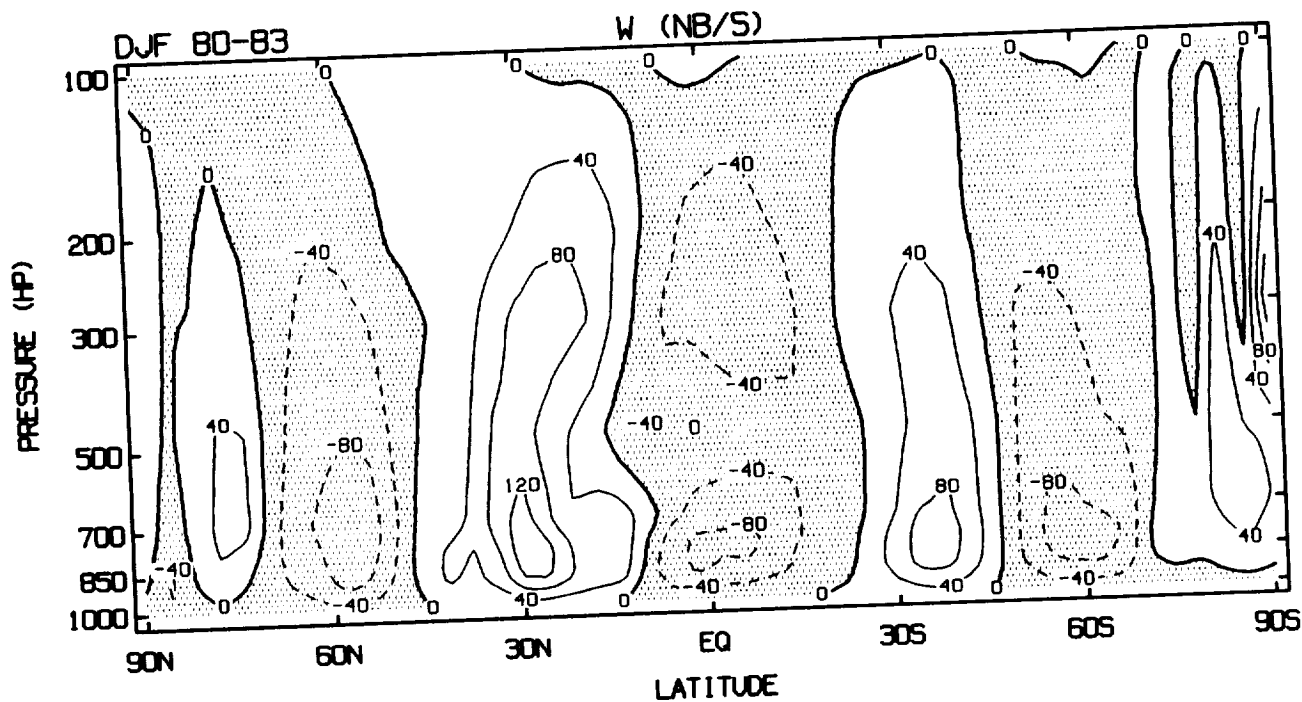


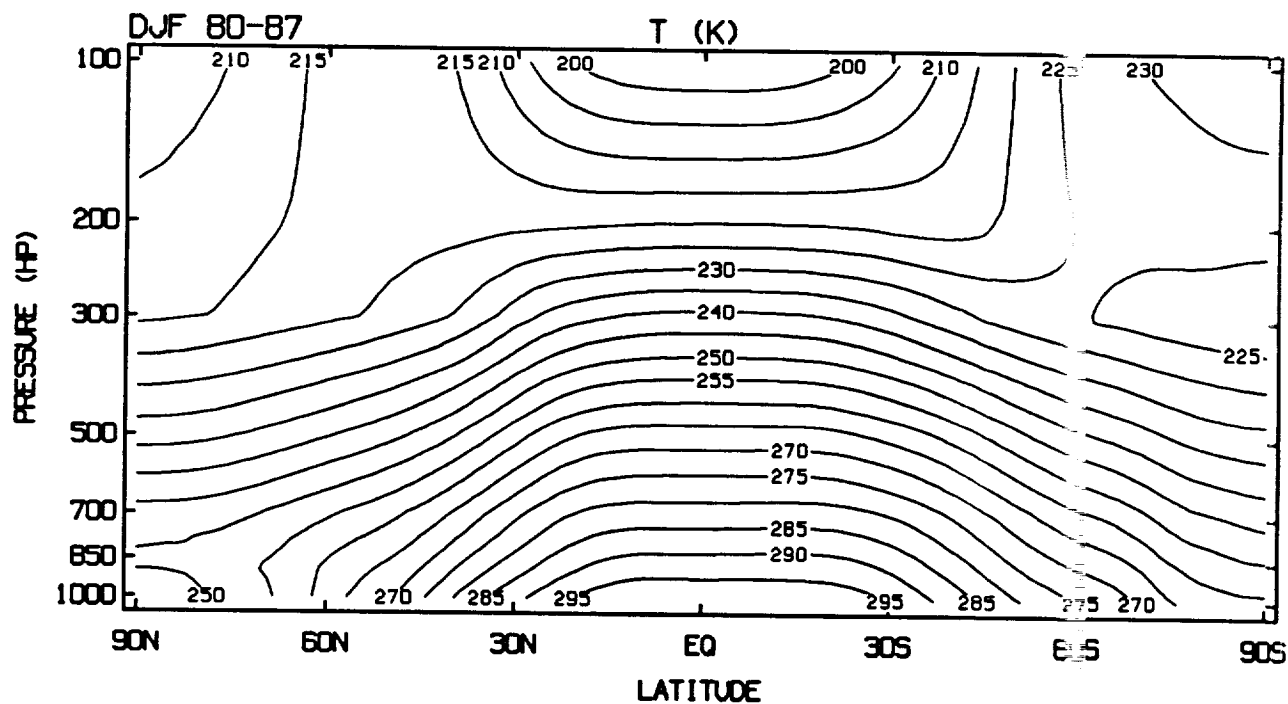
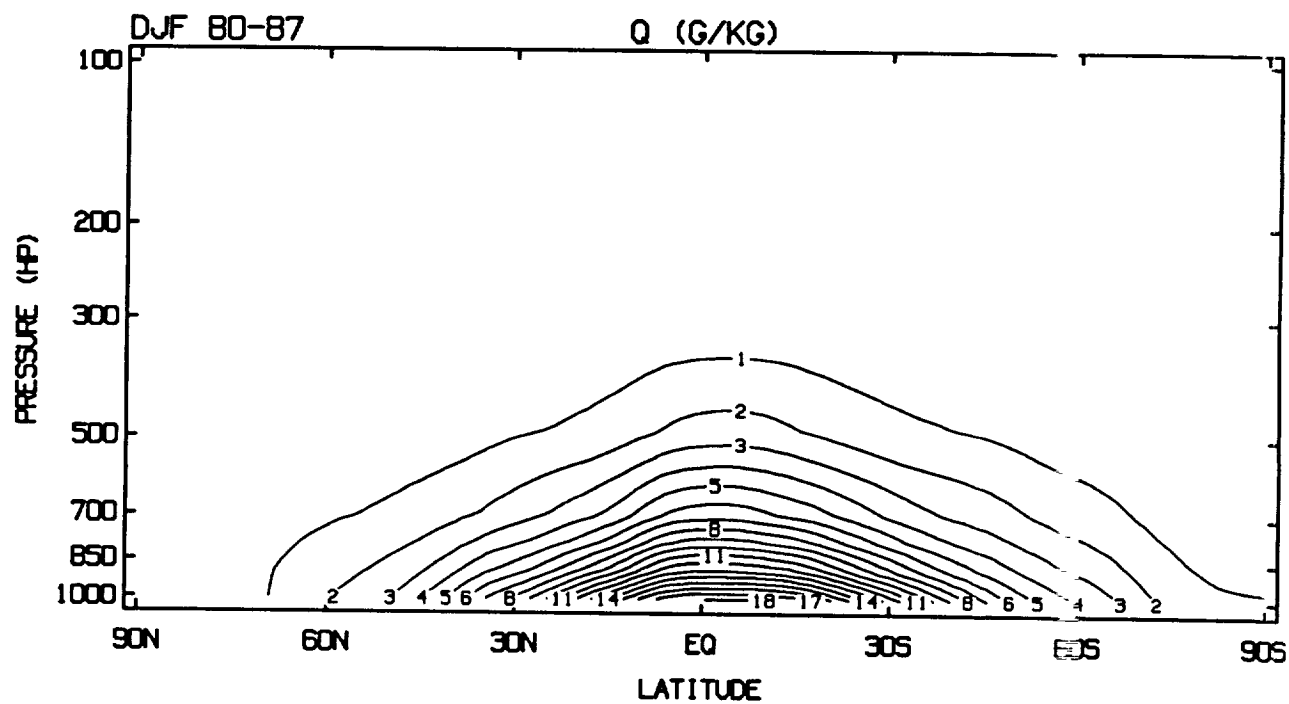




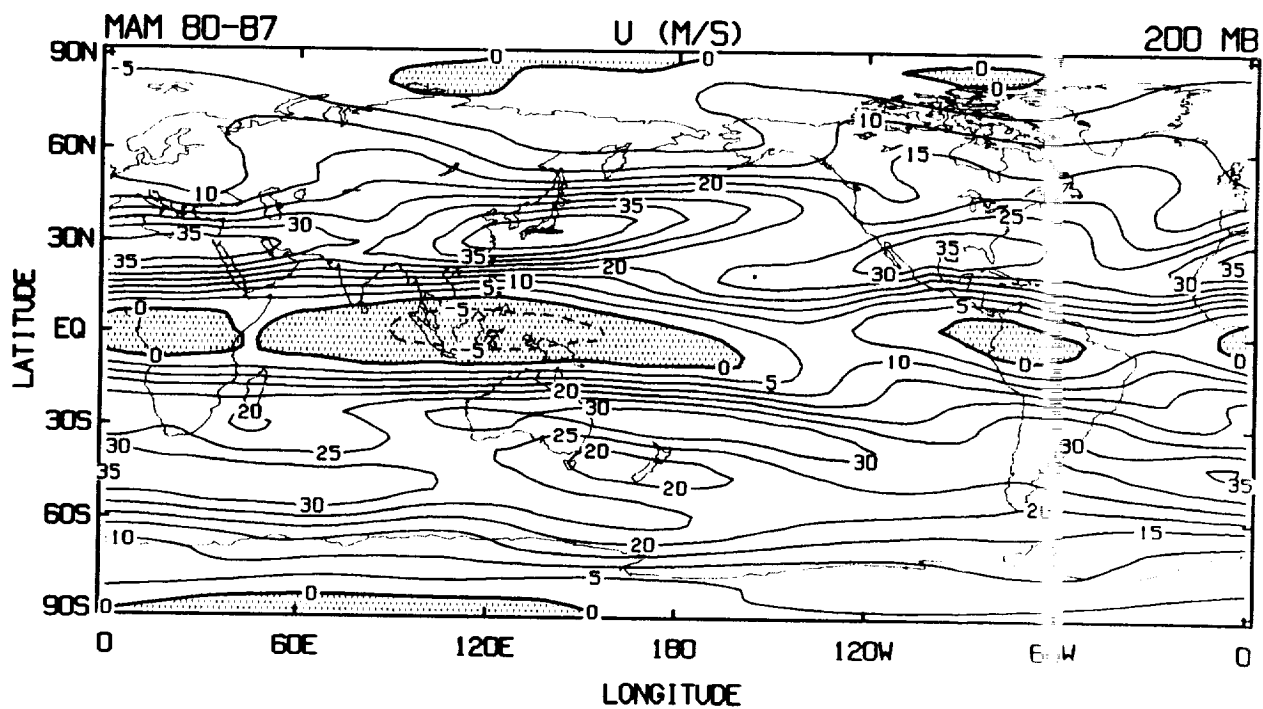
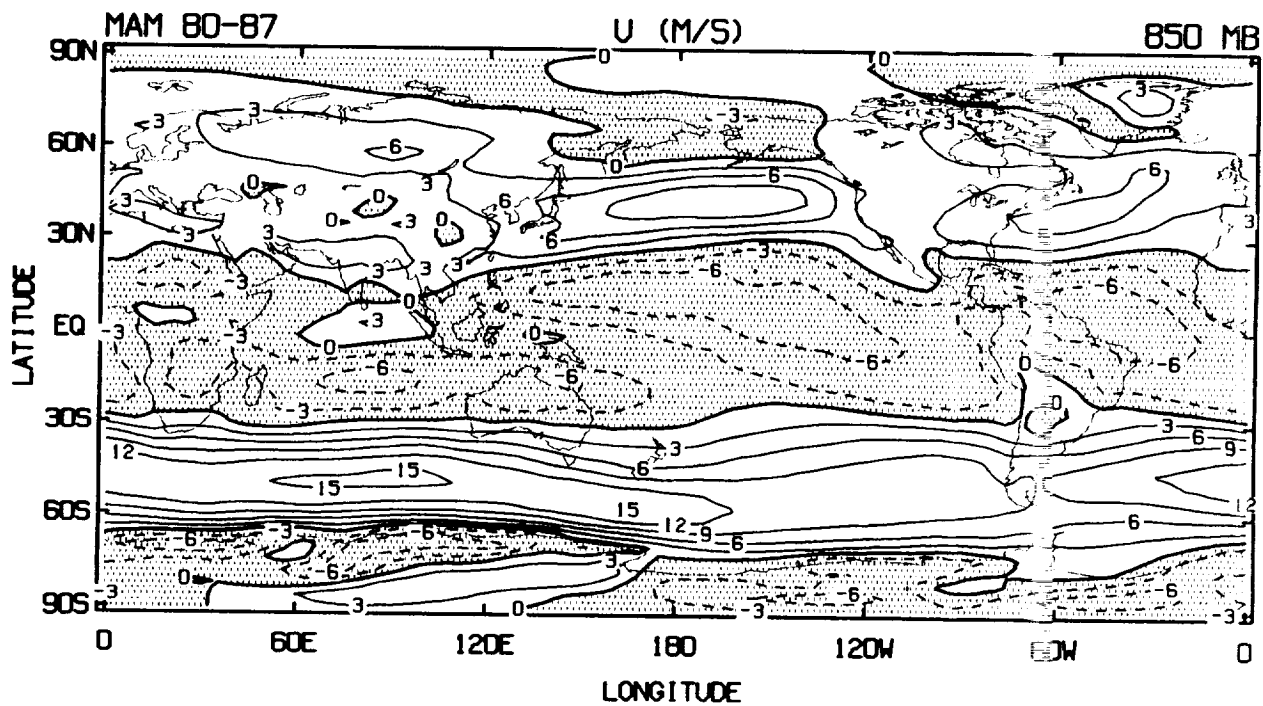


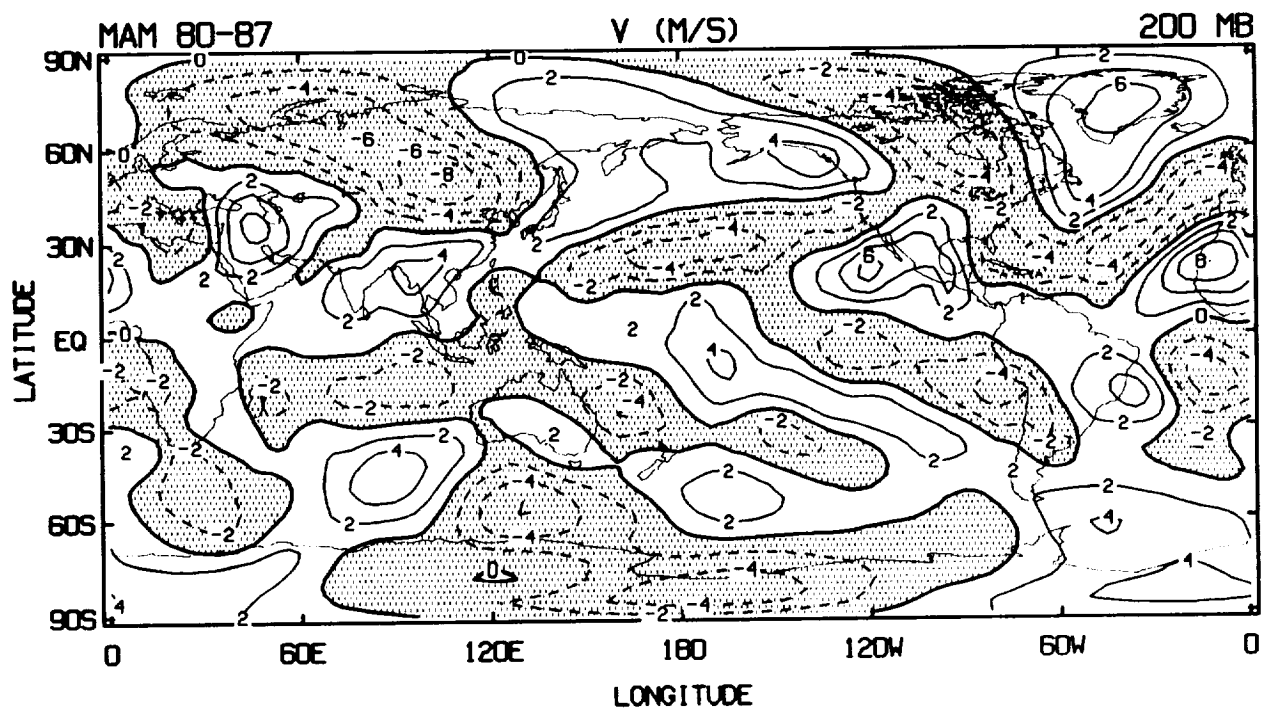
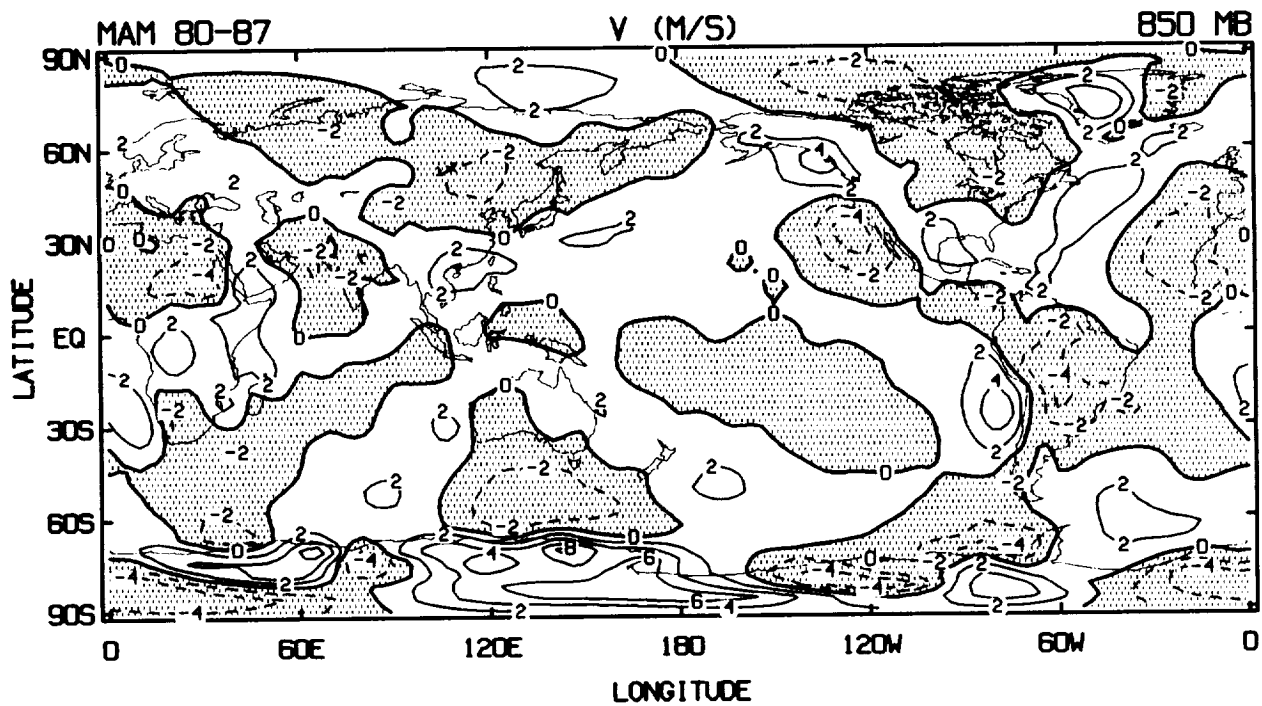


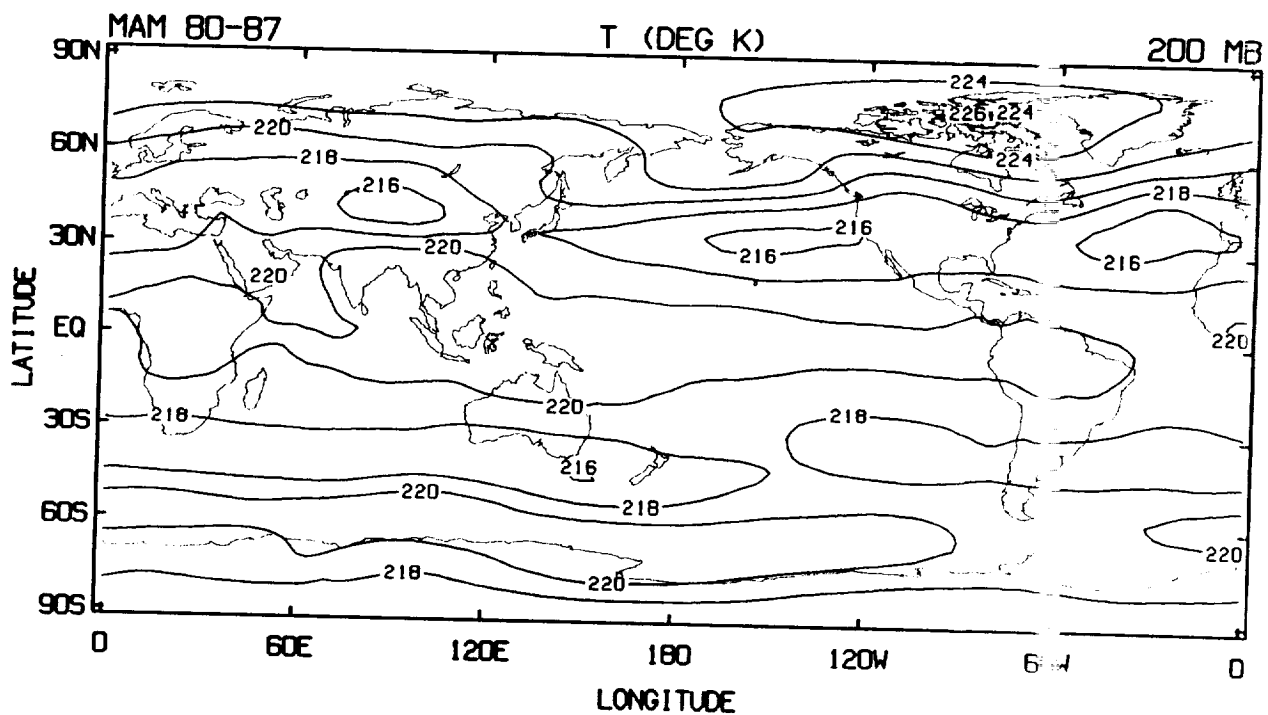
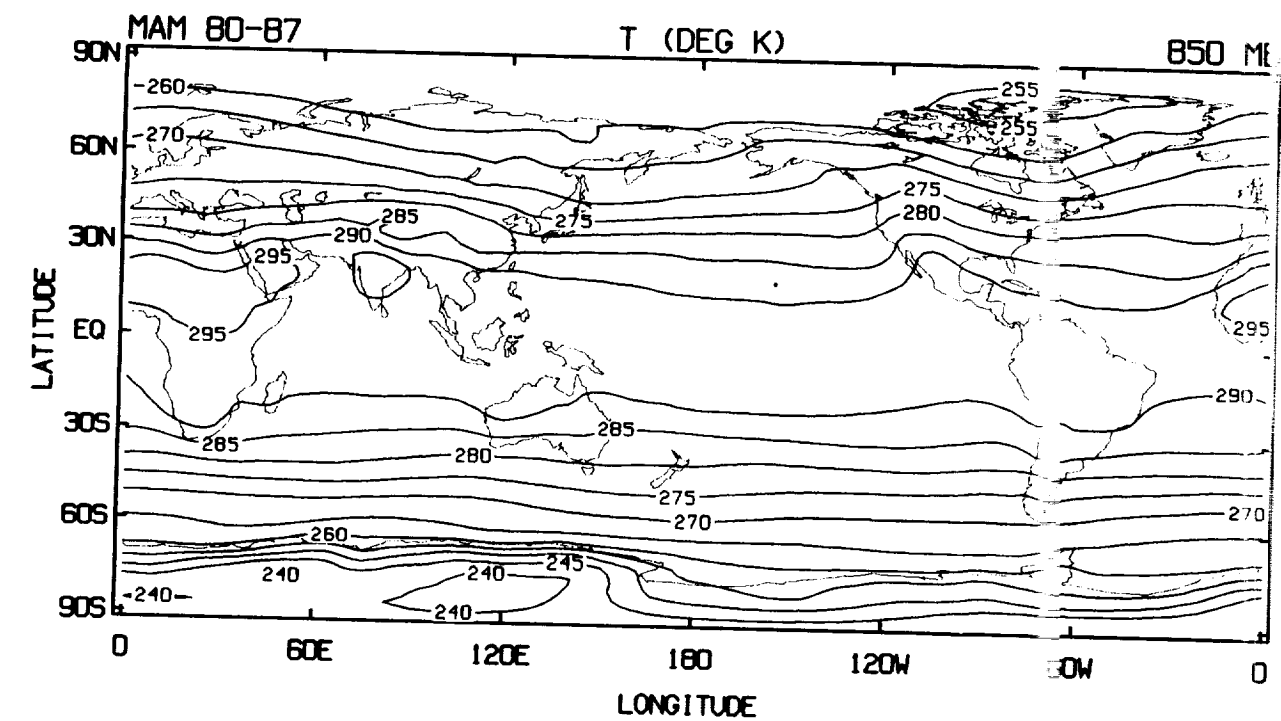


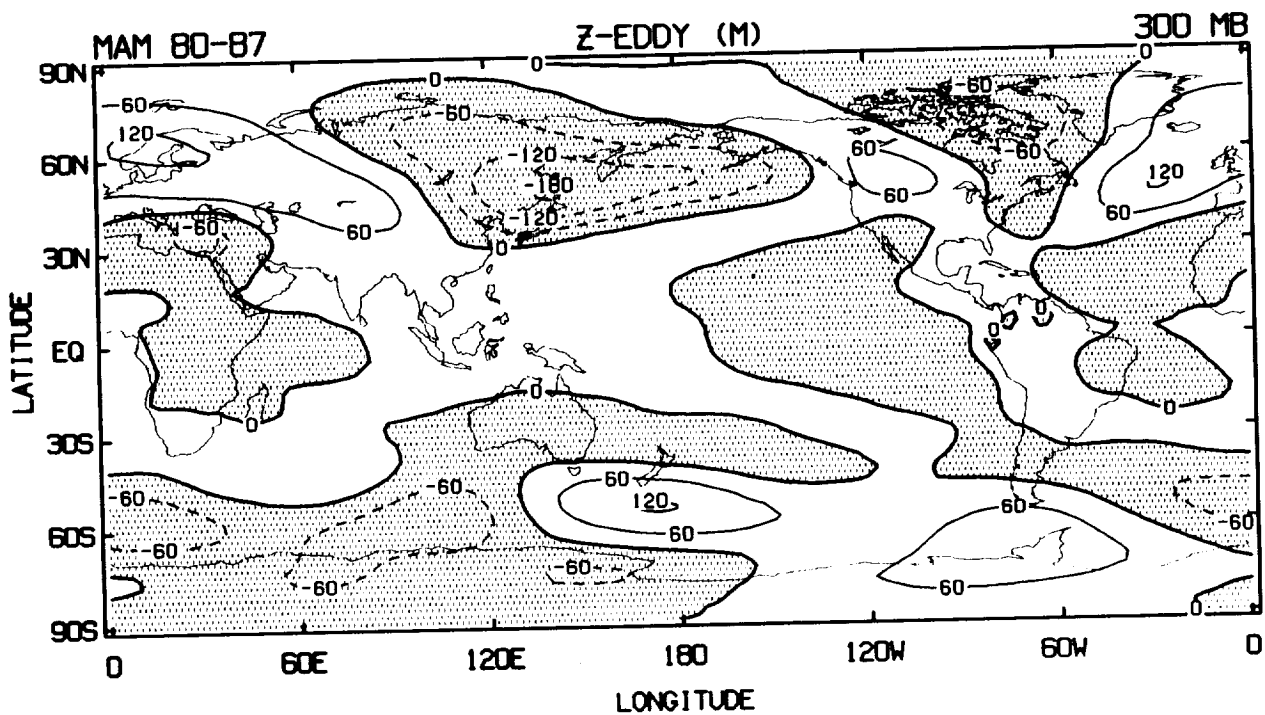
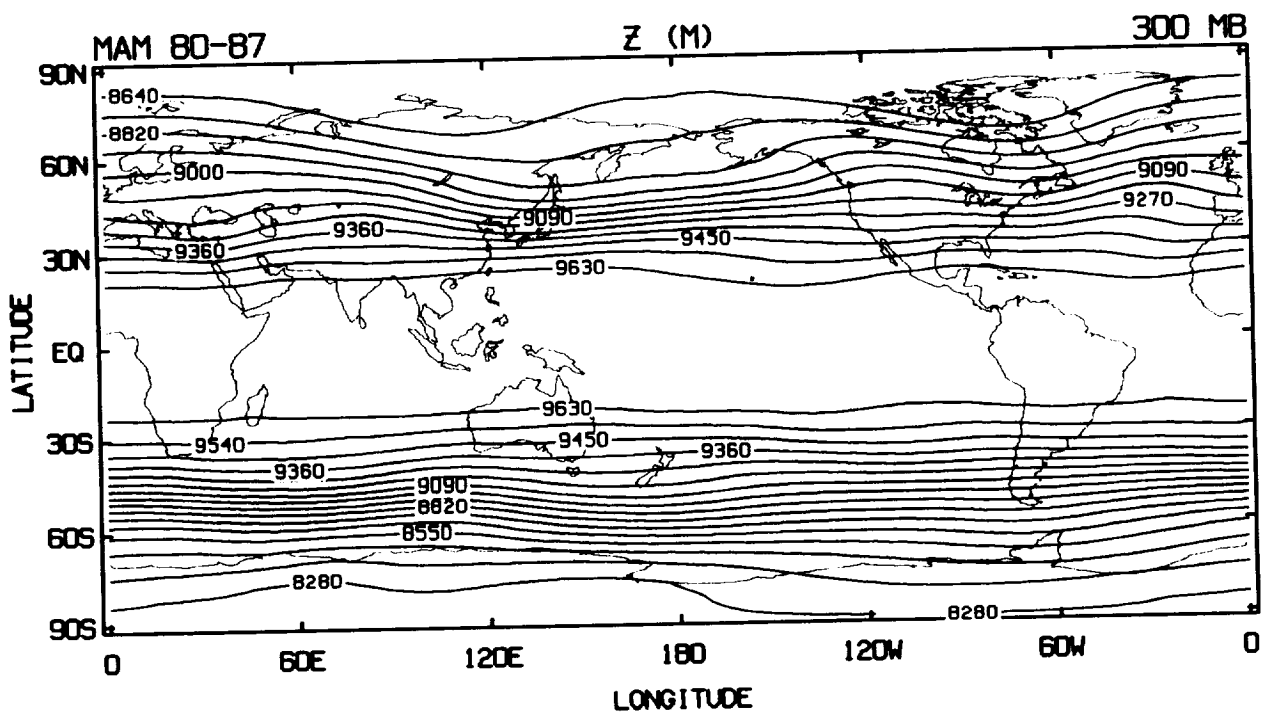


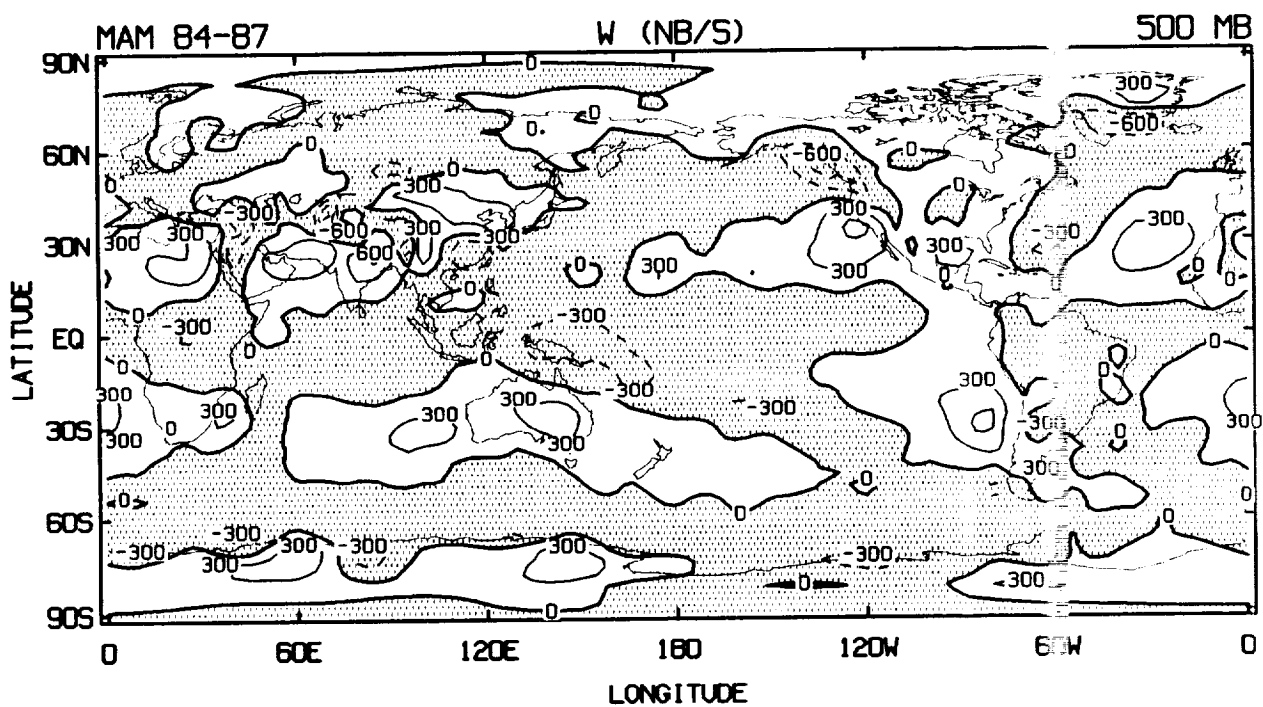
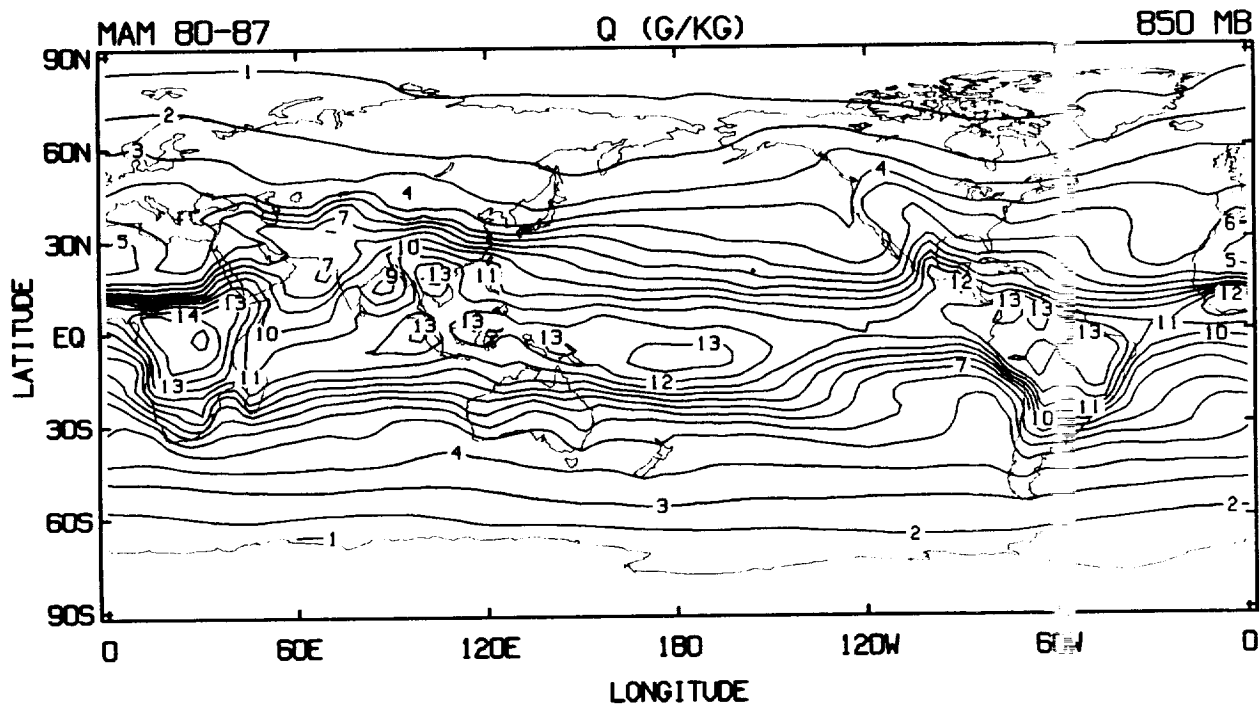
**MARCH
APRIL
MAY**

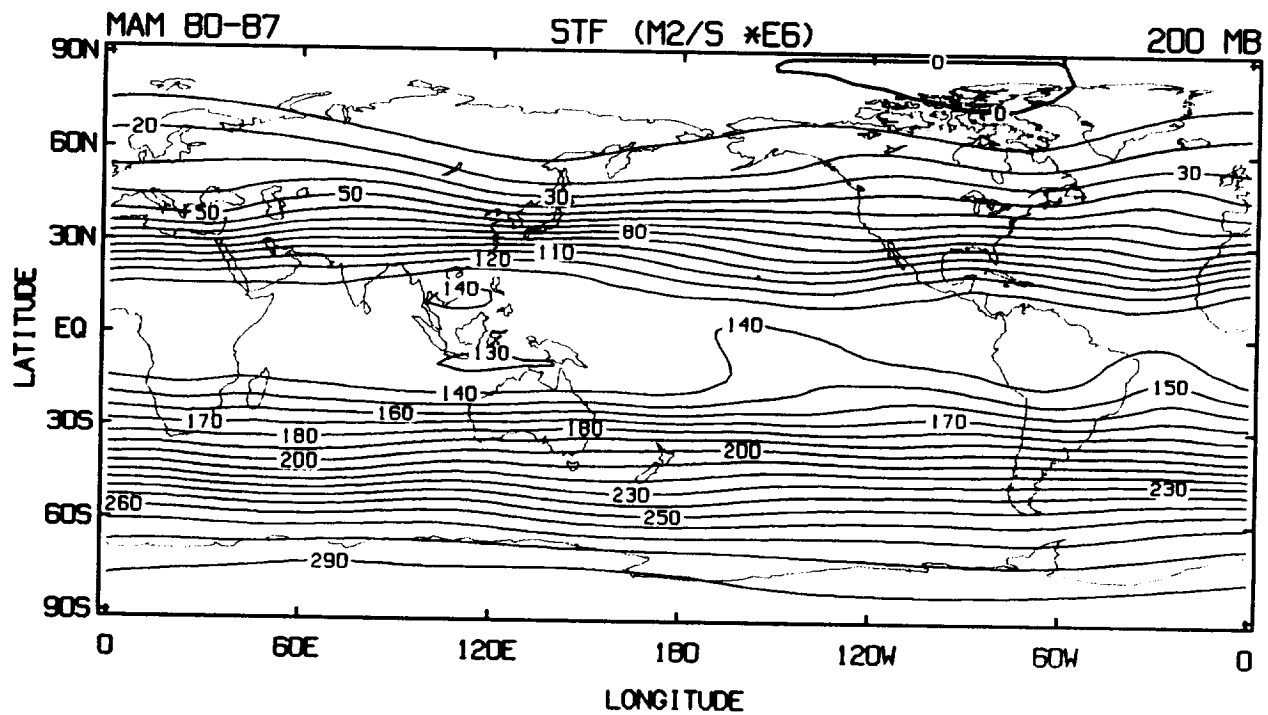
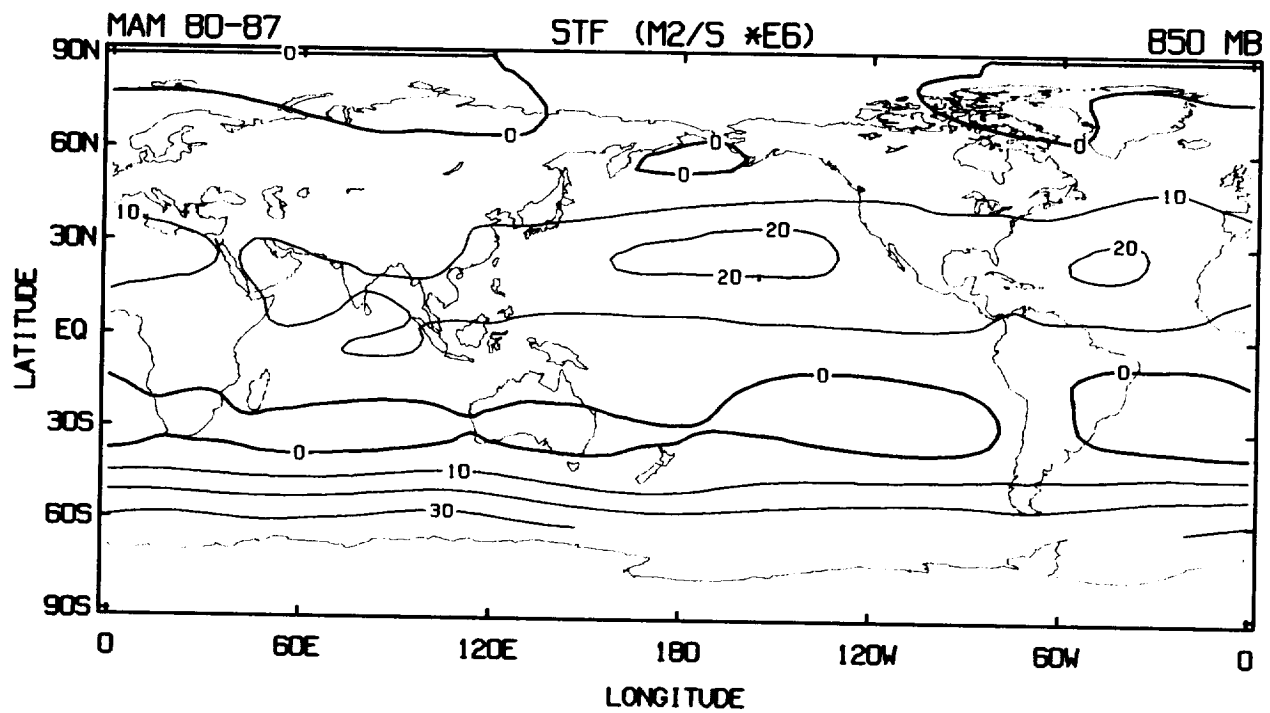


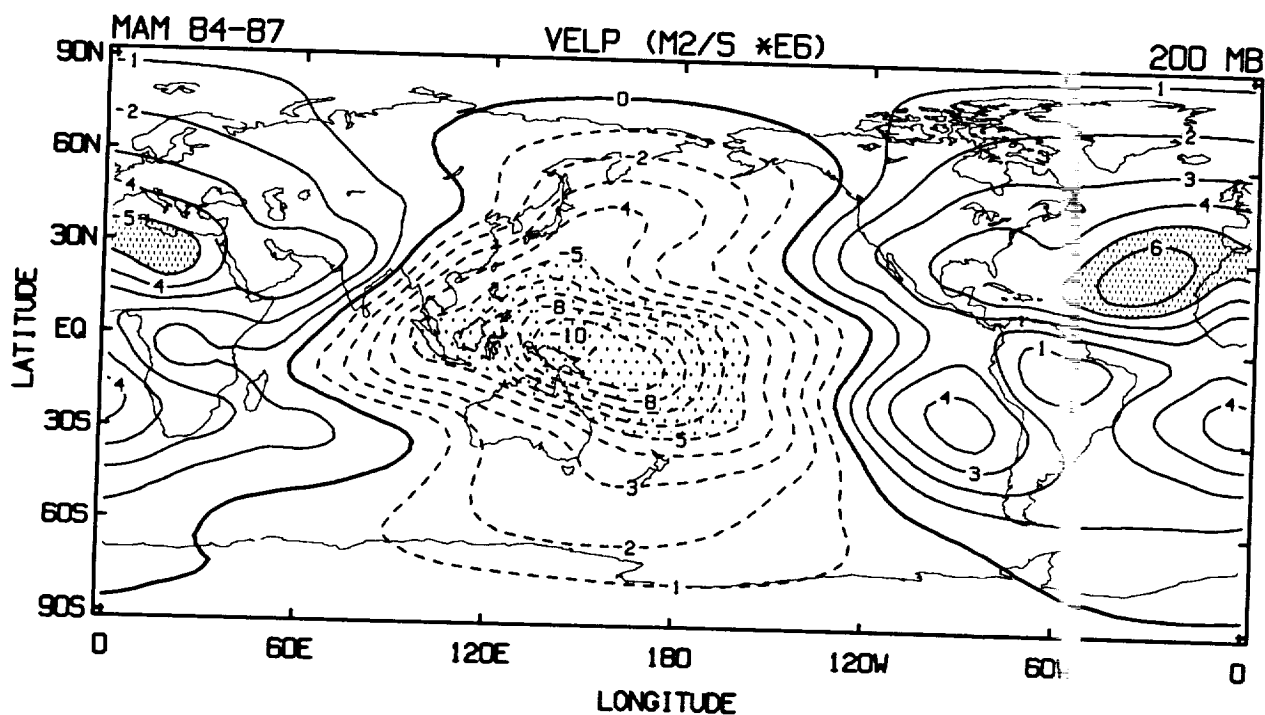
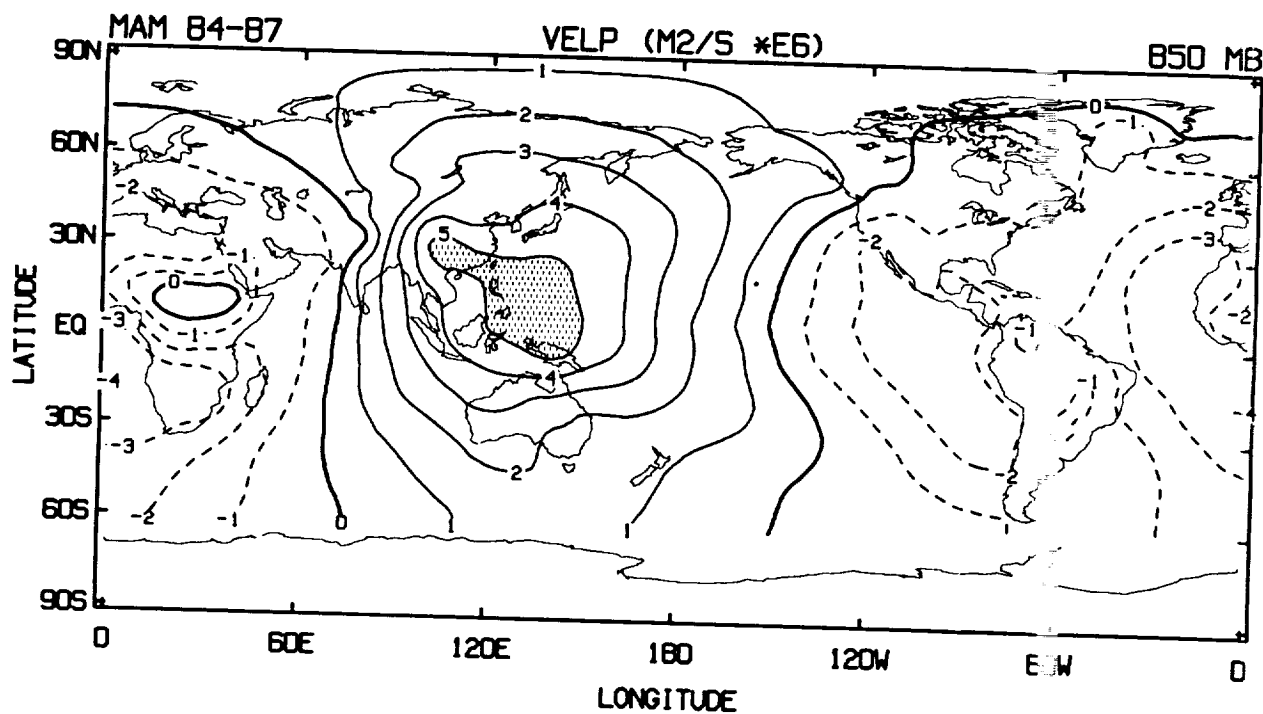


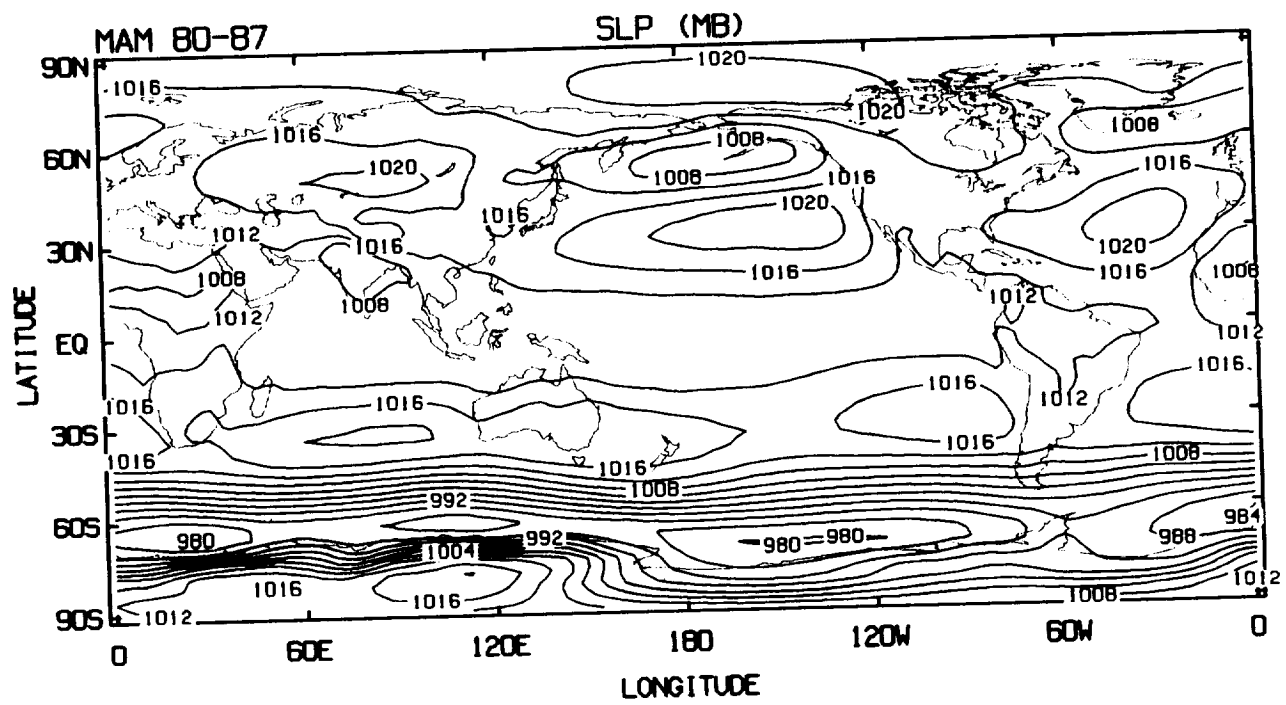


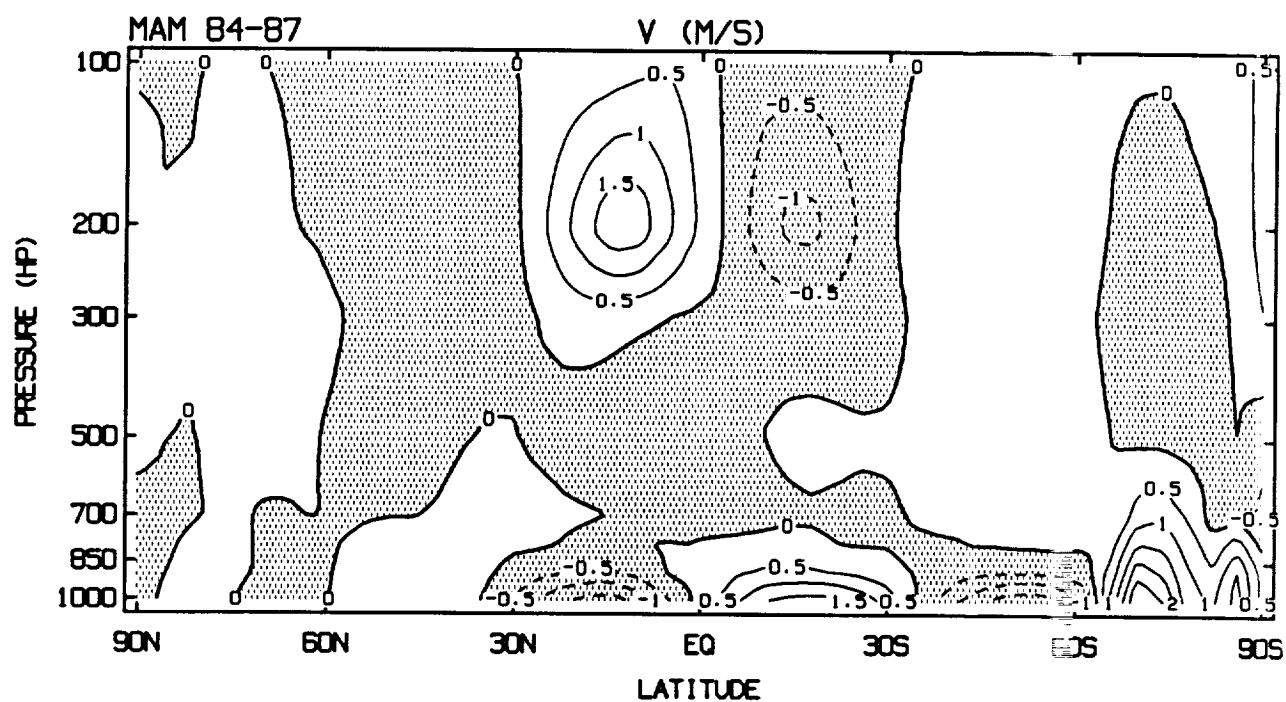
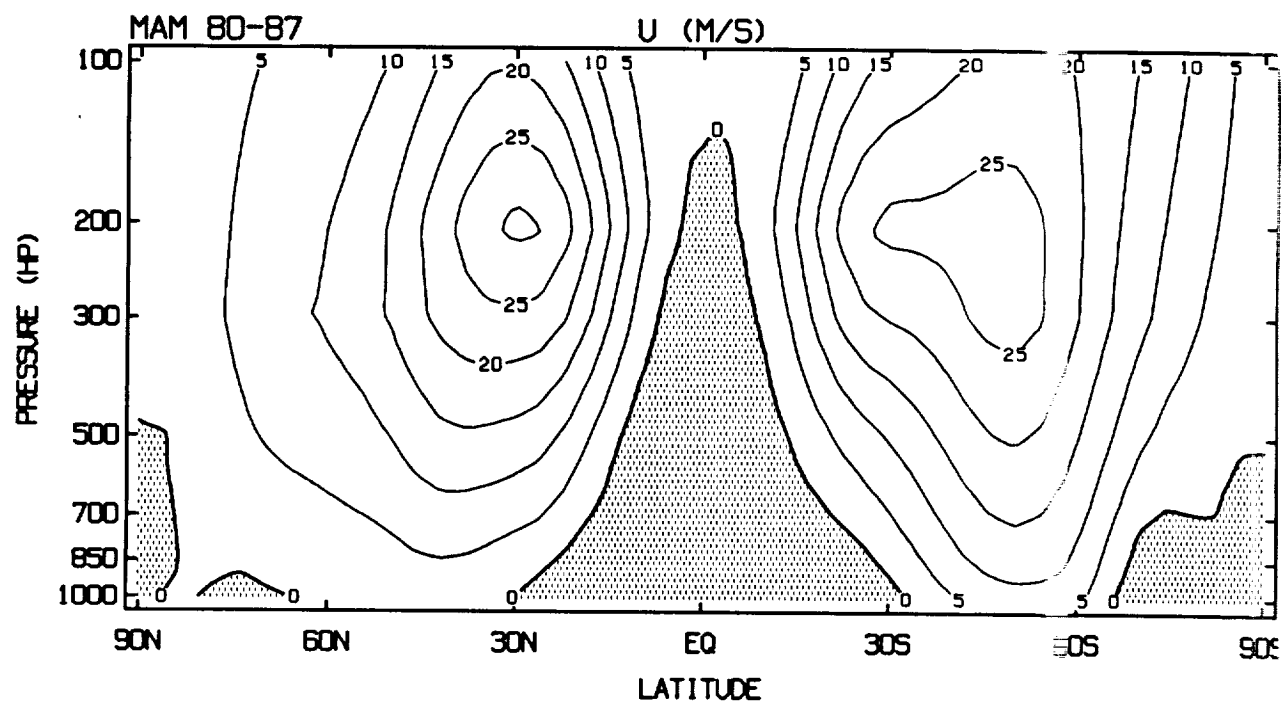


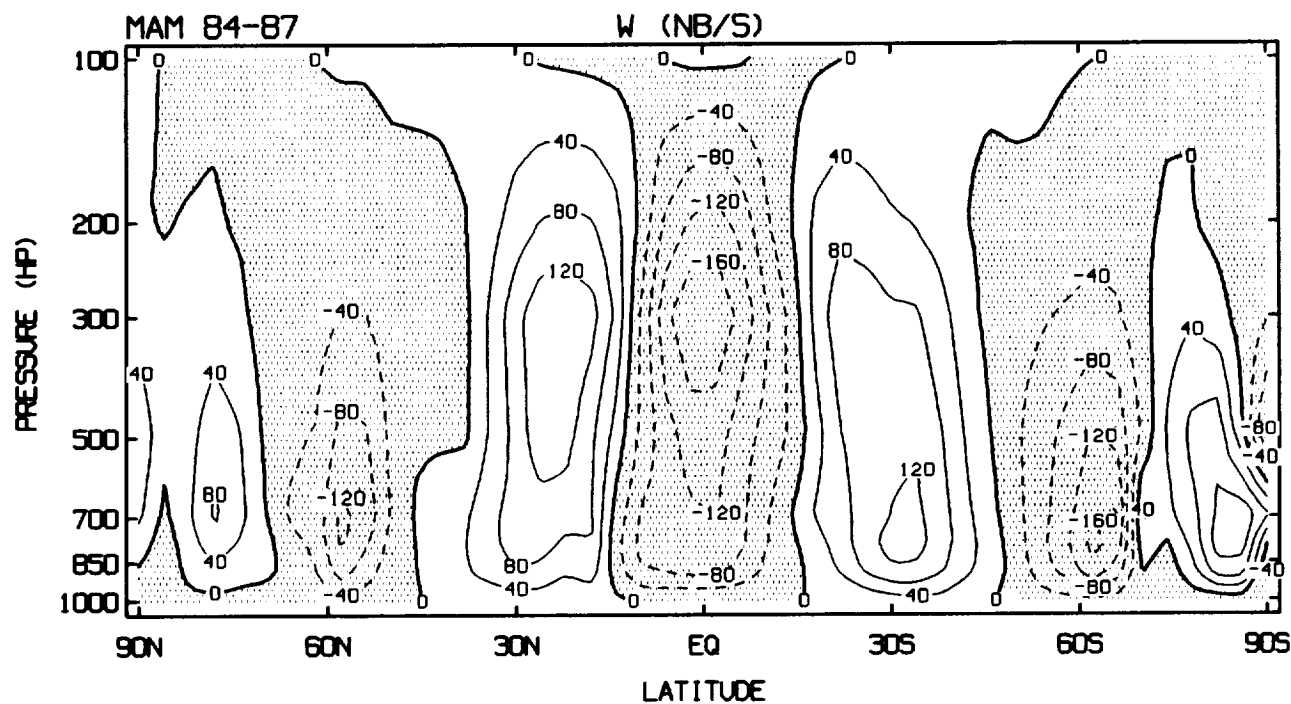
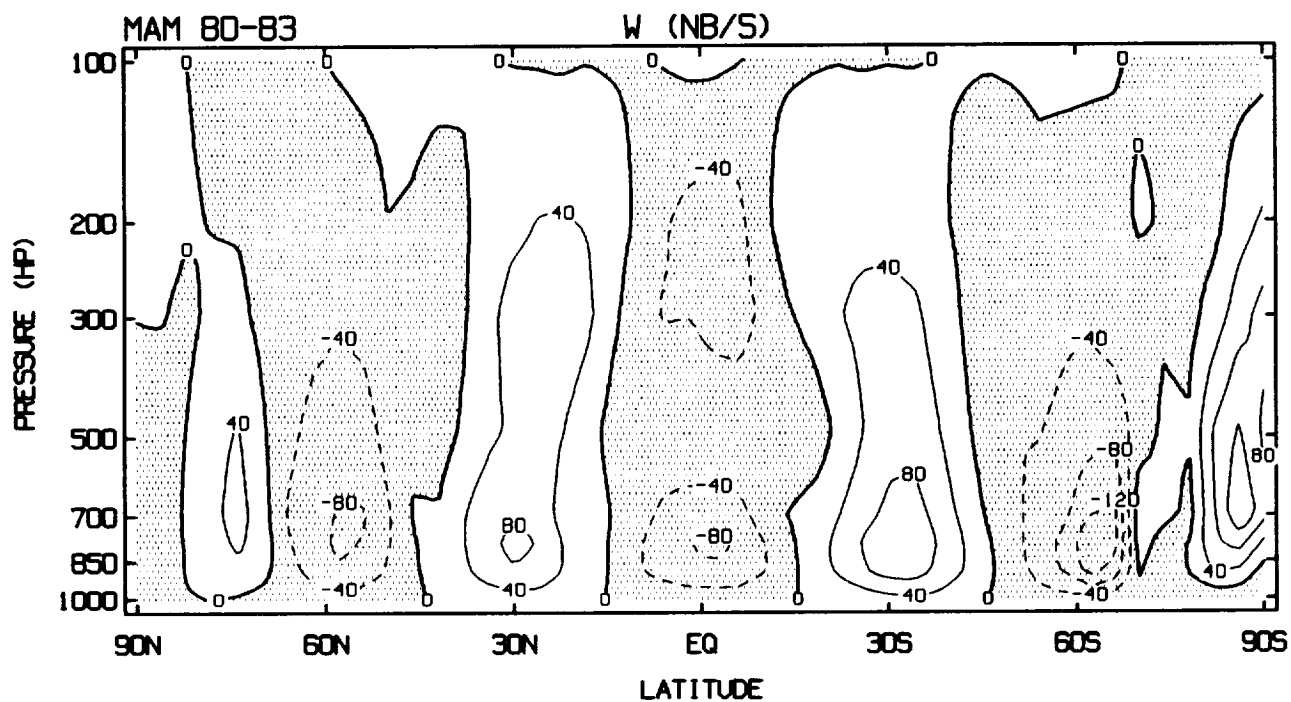


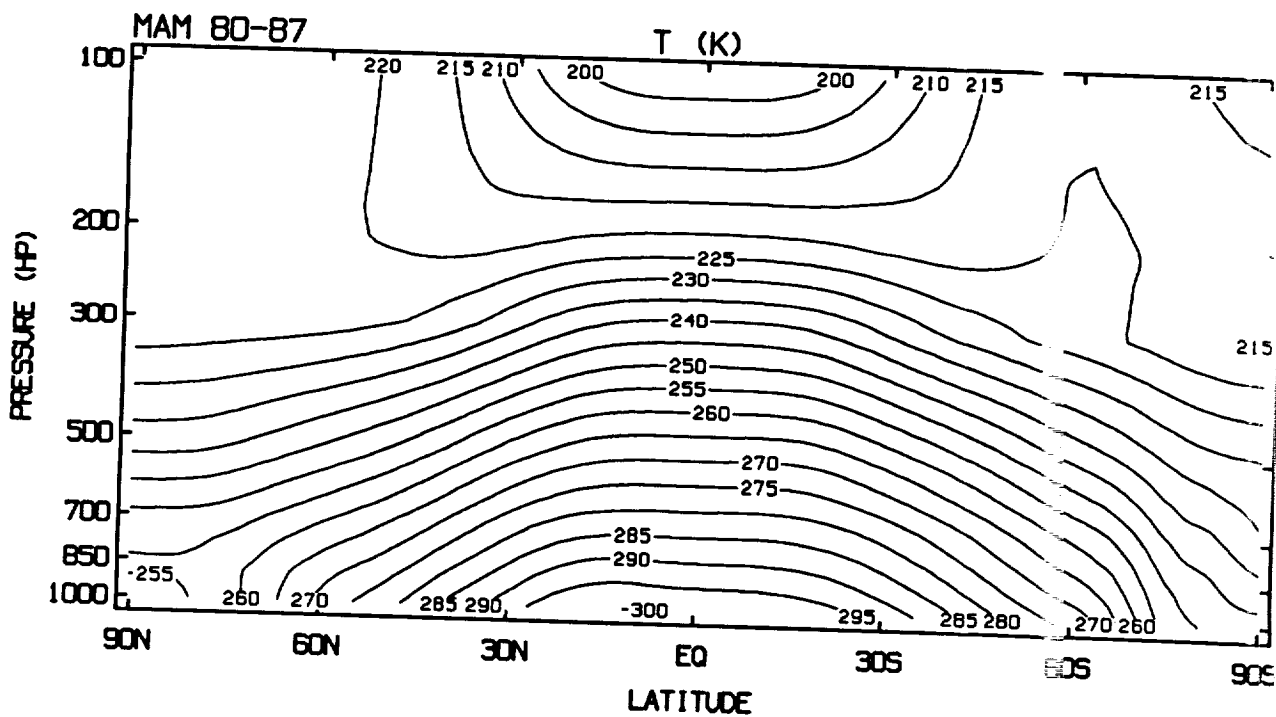
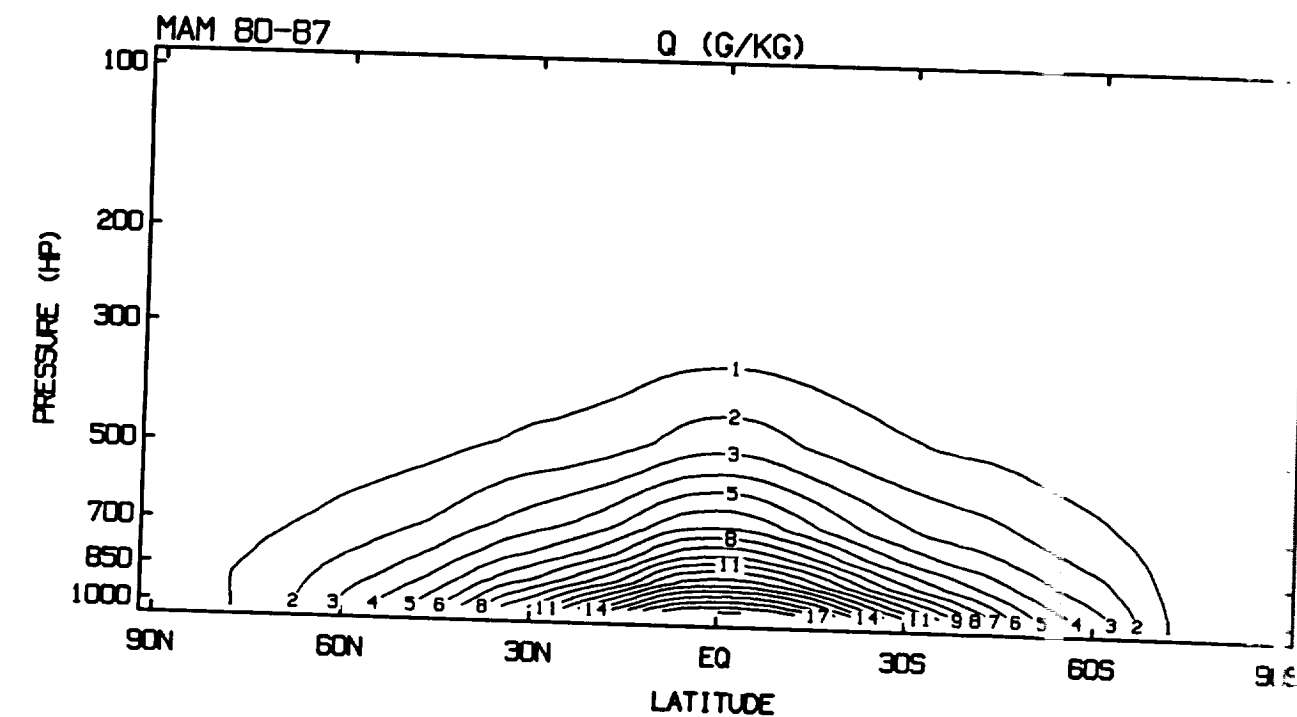




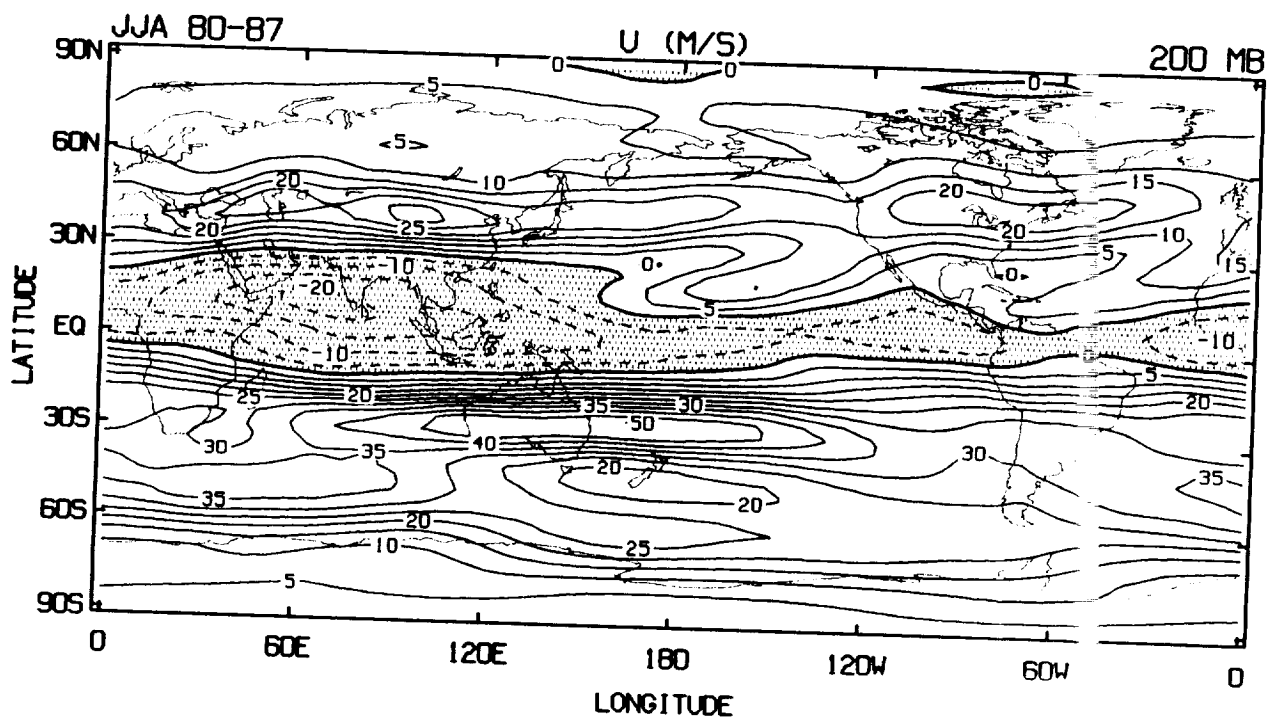
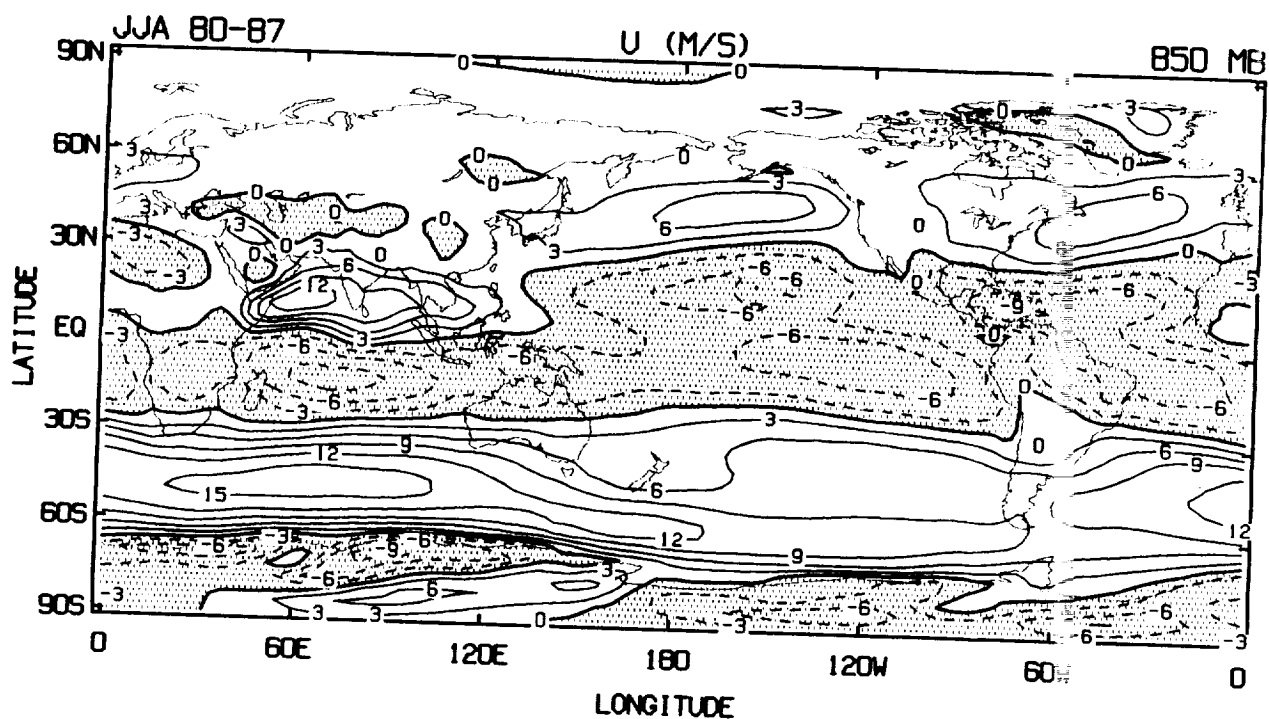


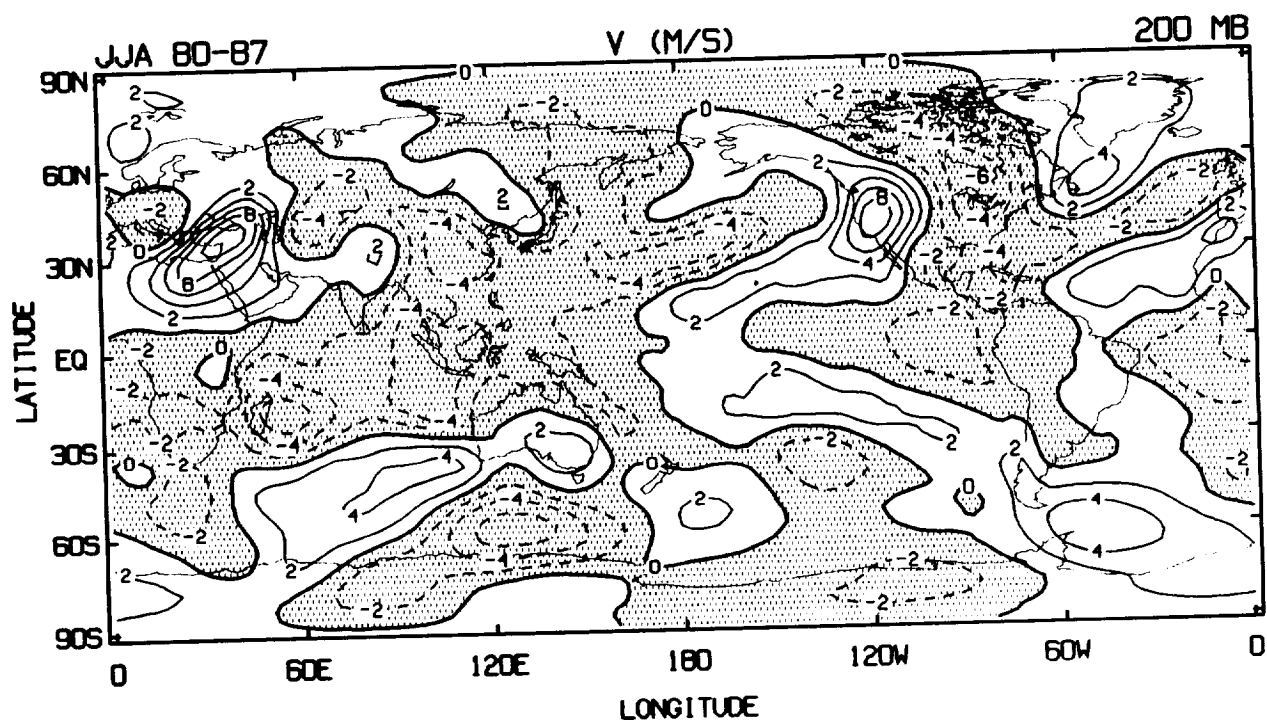
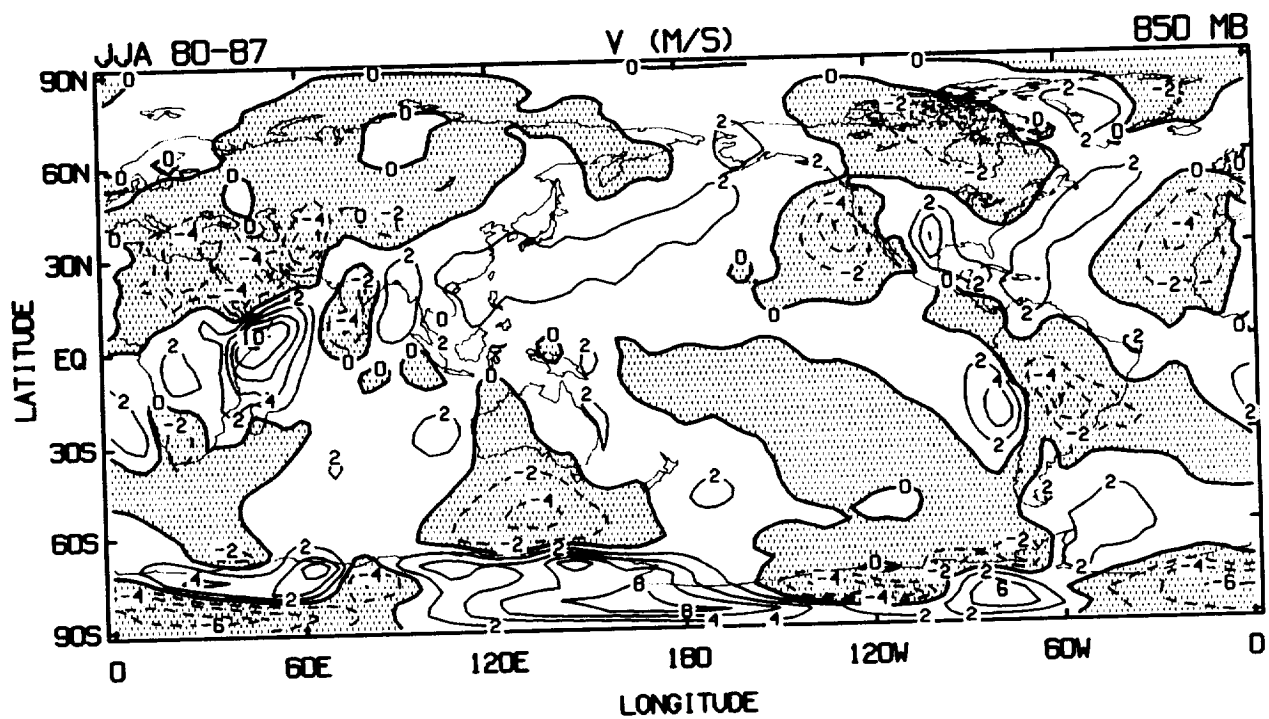


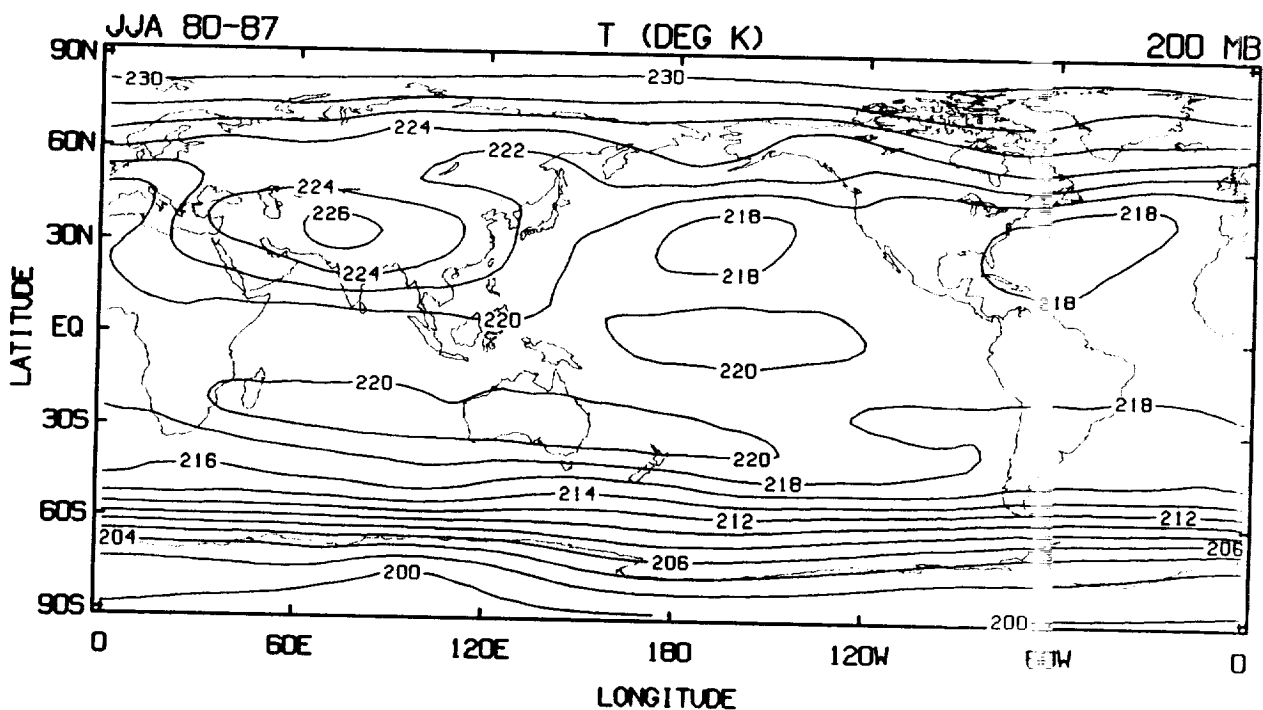
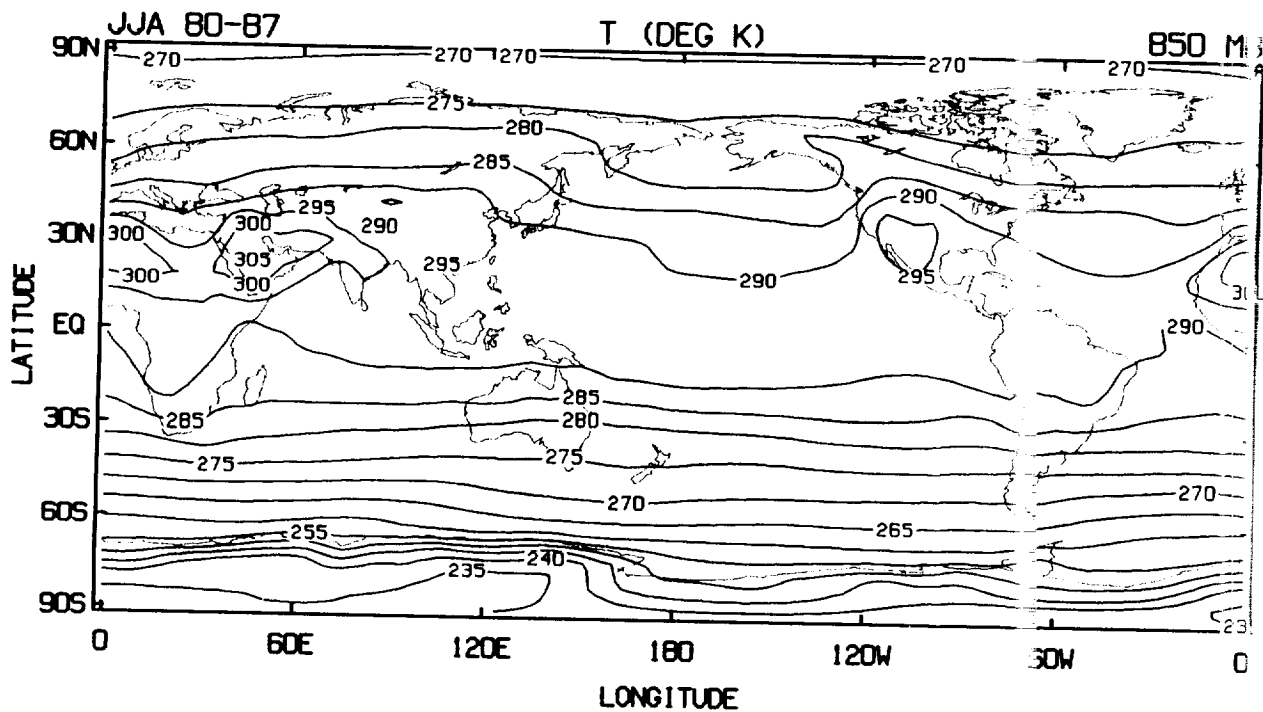


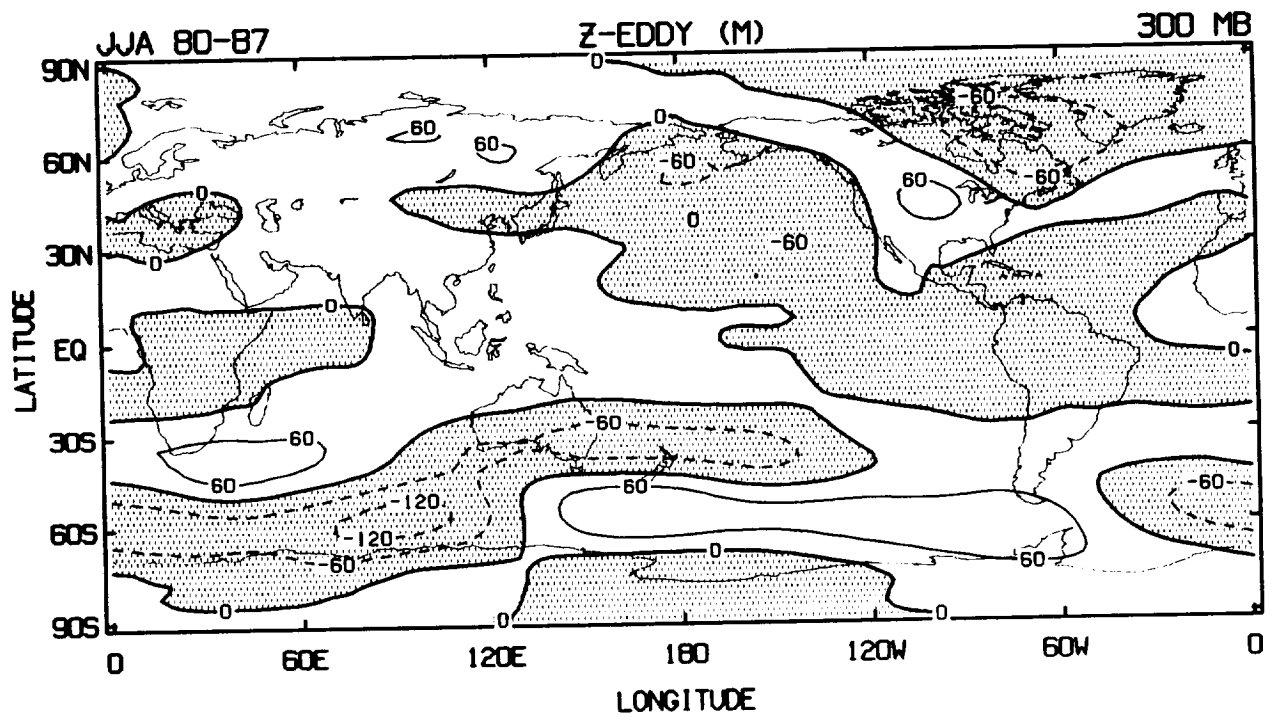
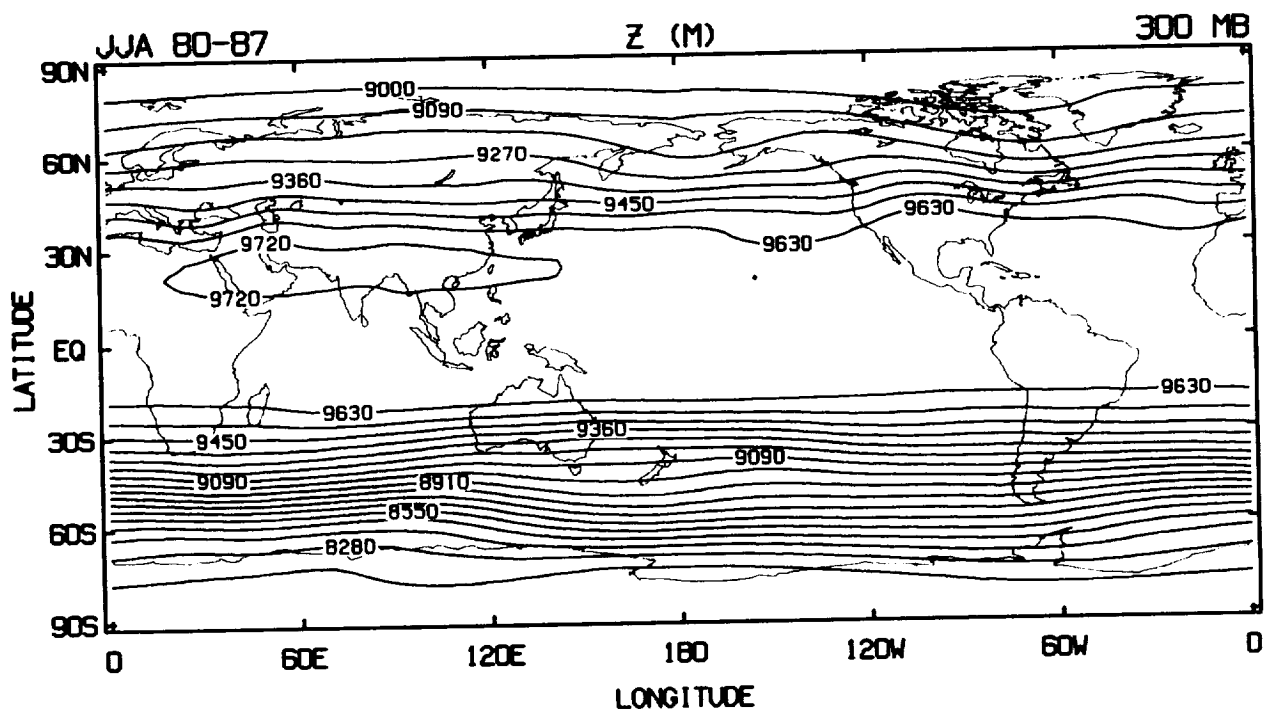


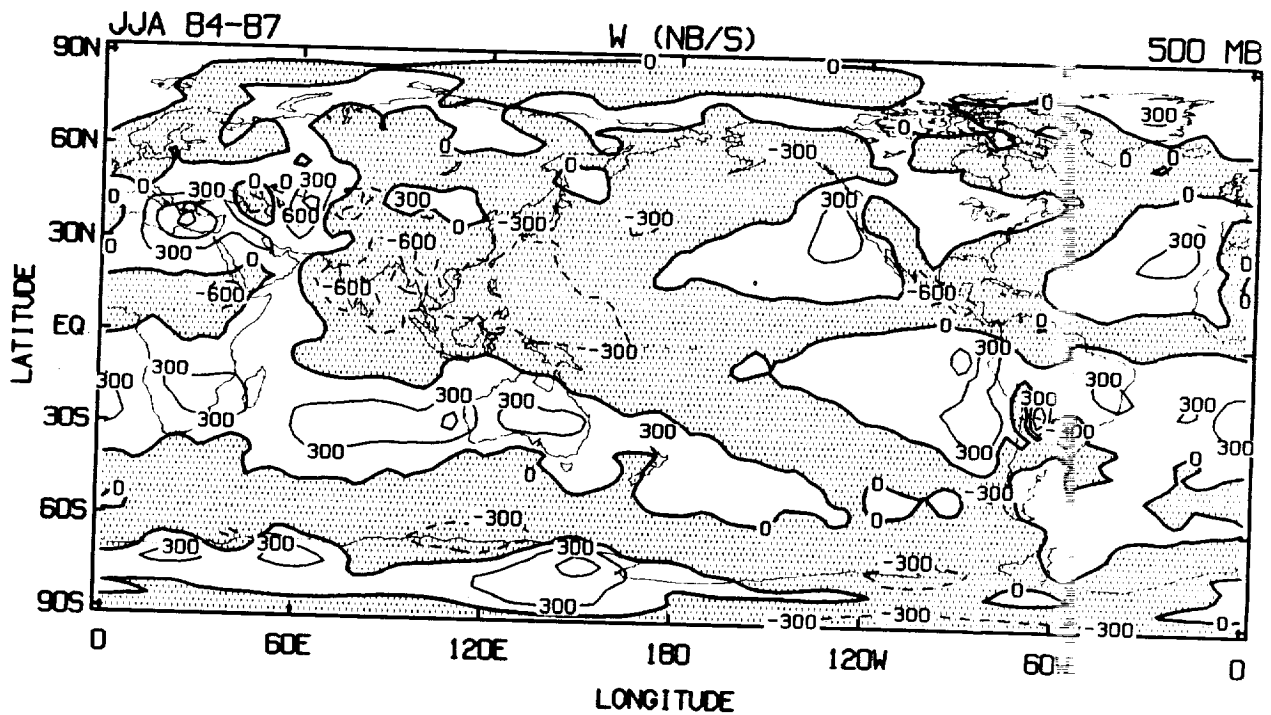
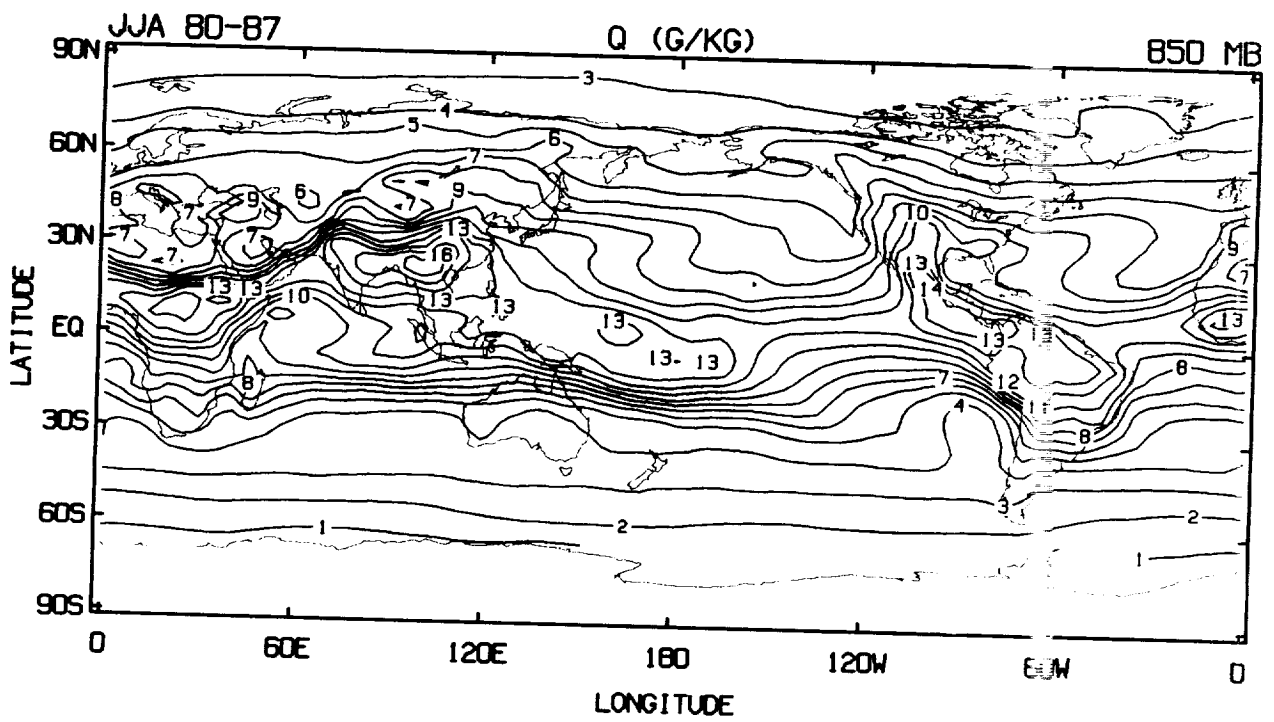
**JUNE
JULY
AUGUST**

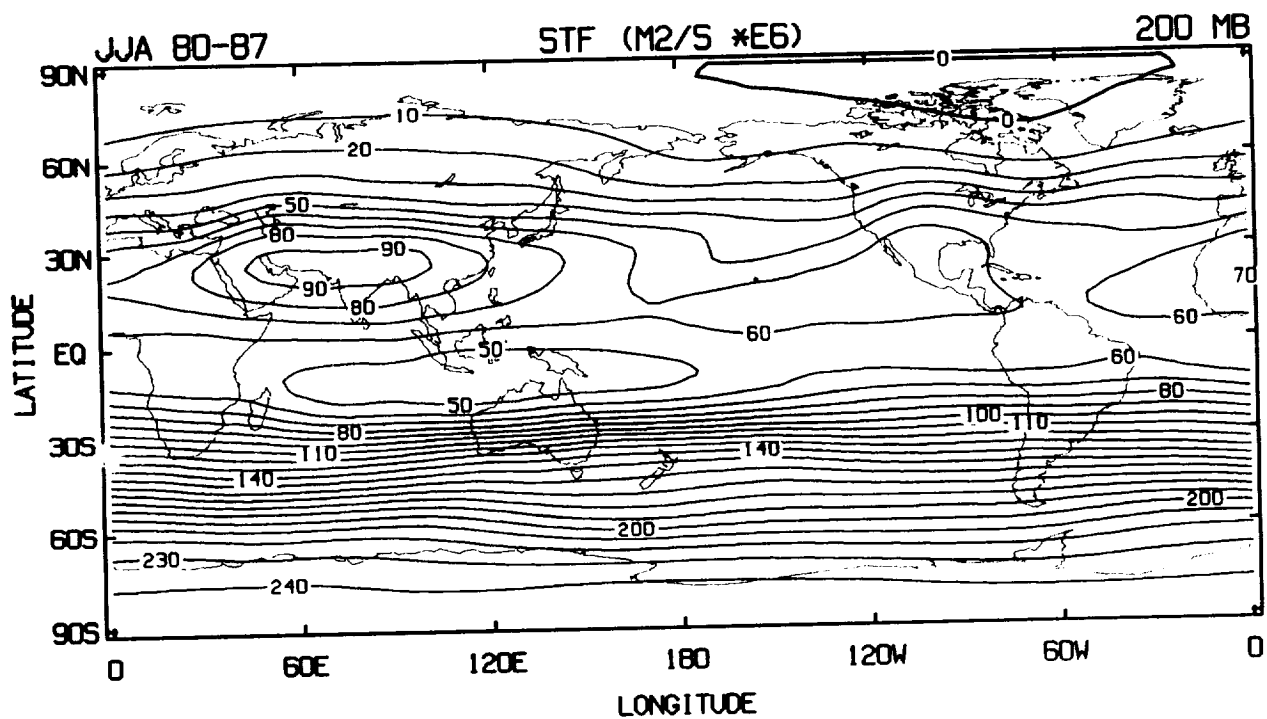
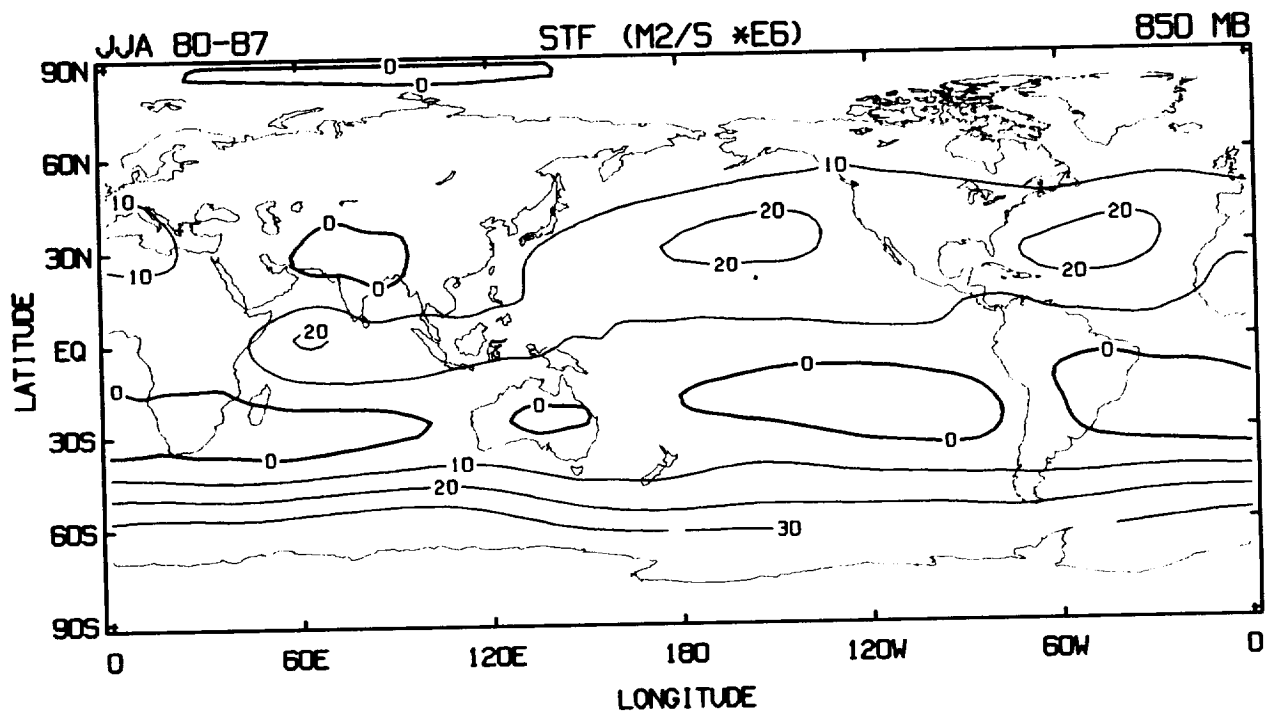


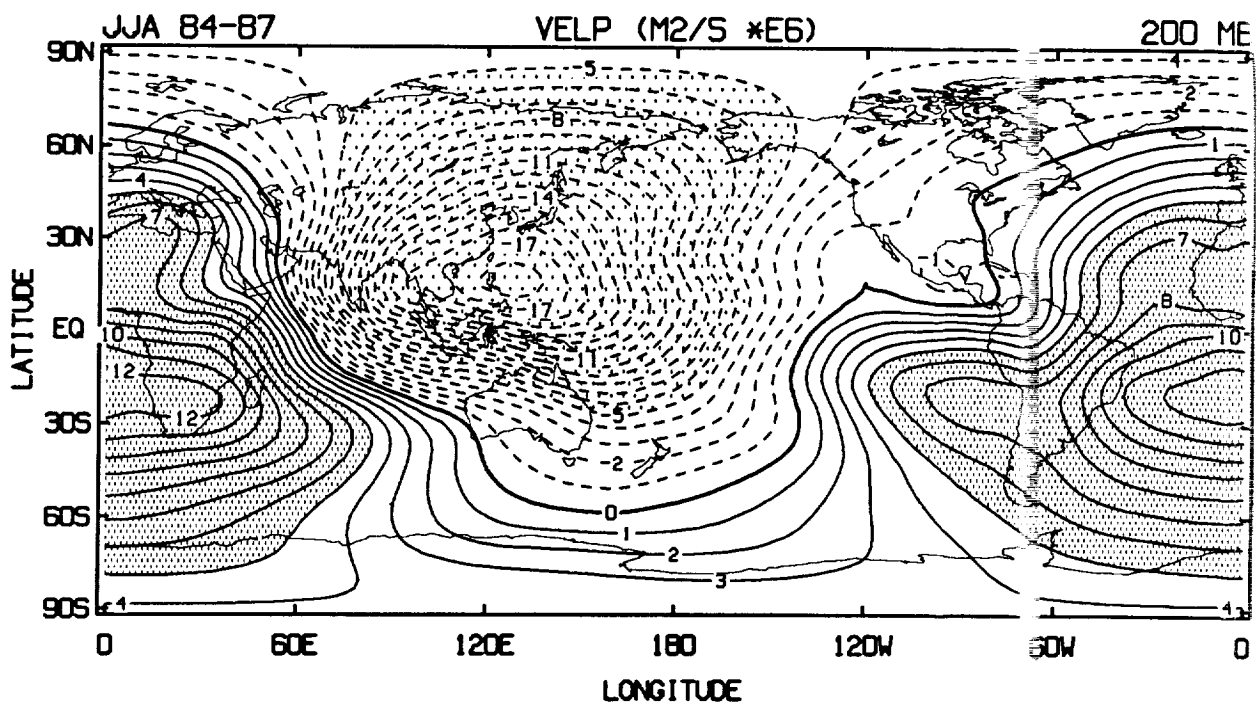
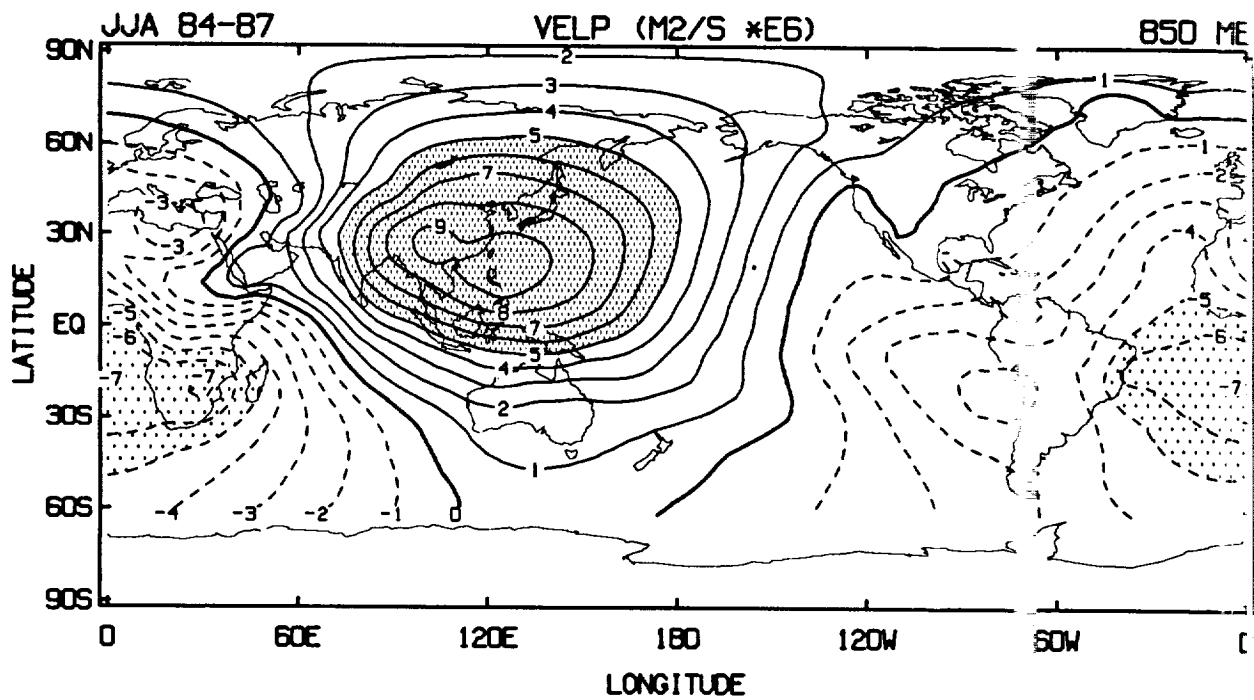


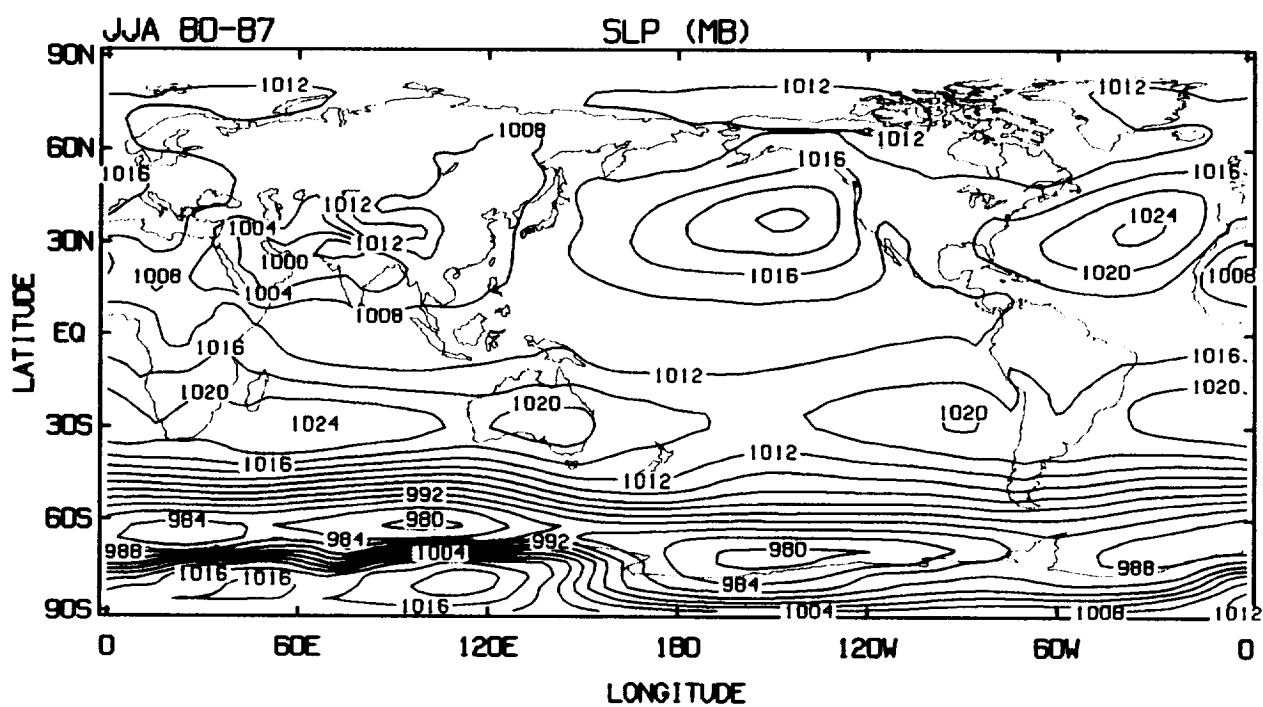


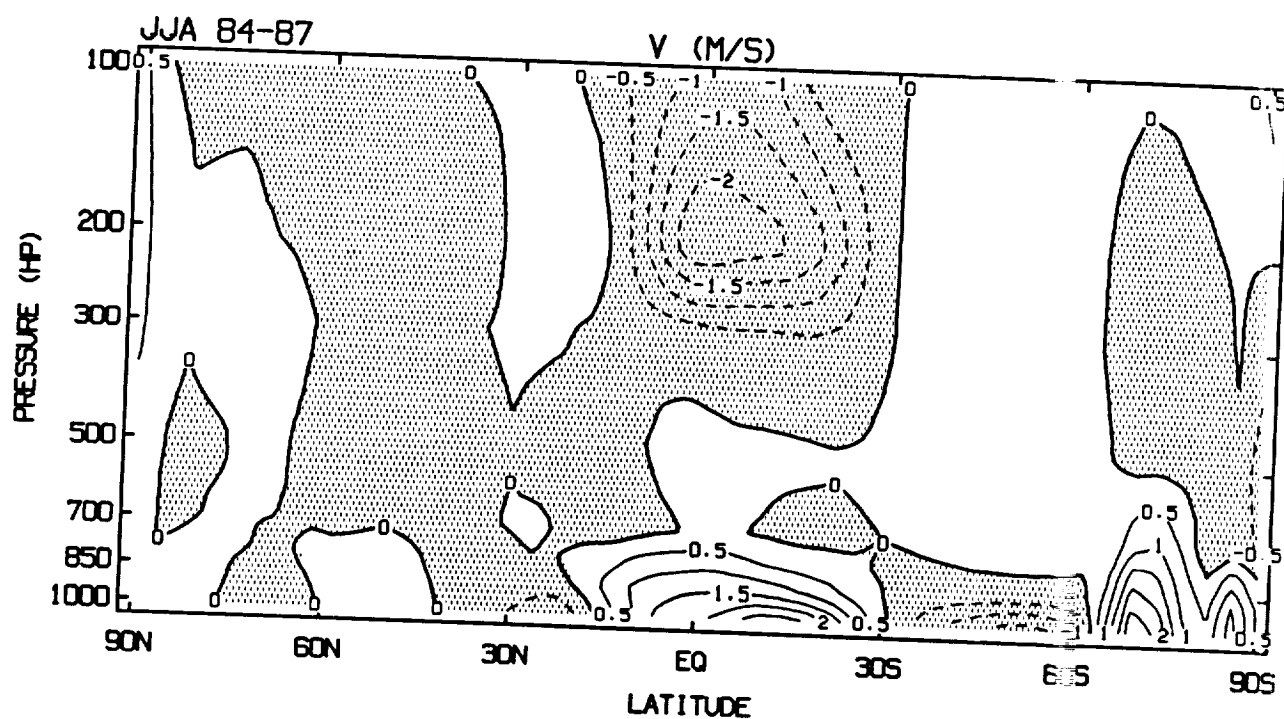
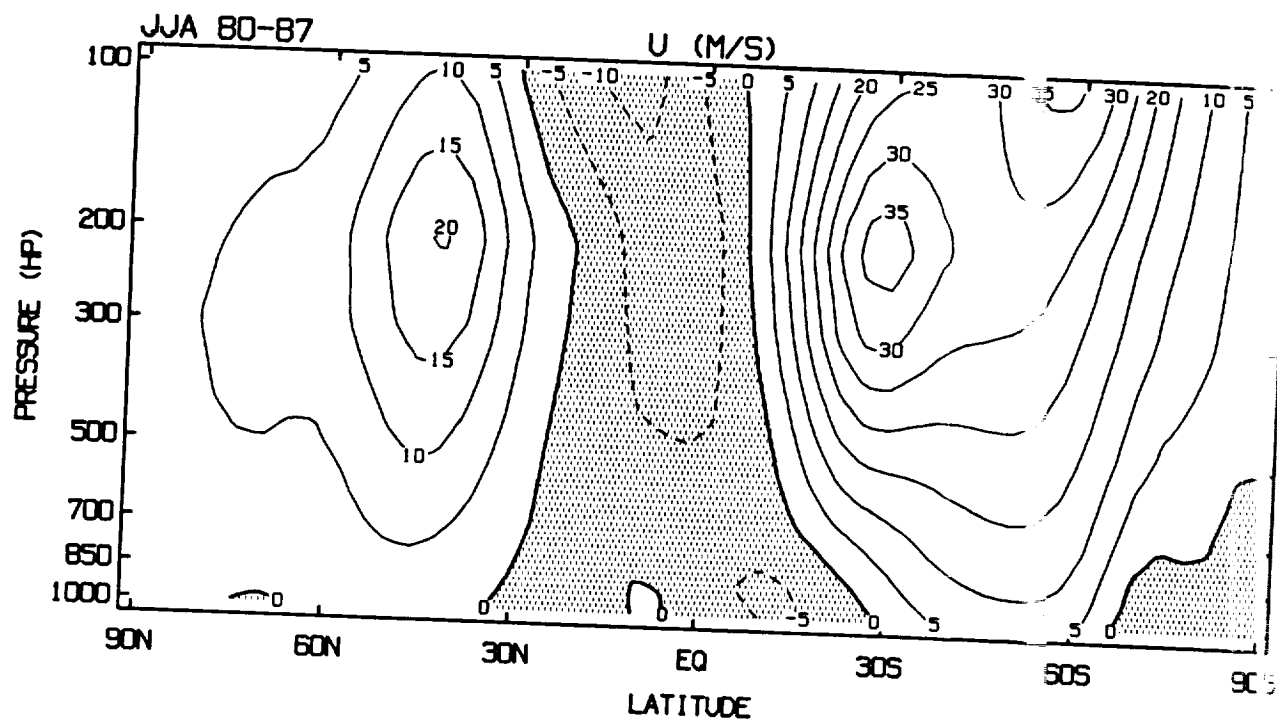


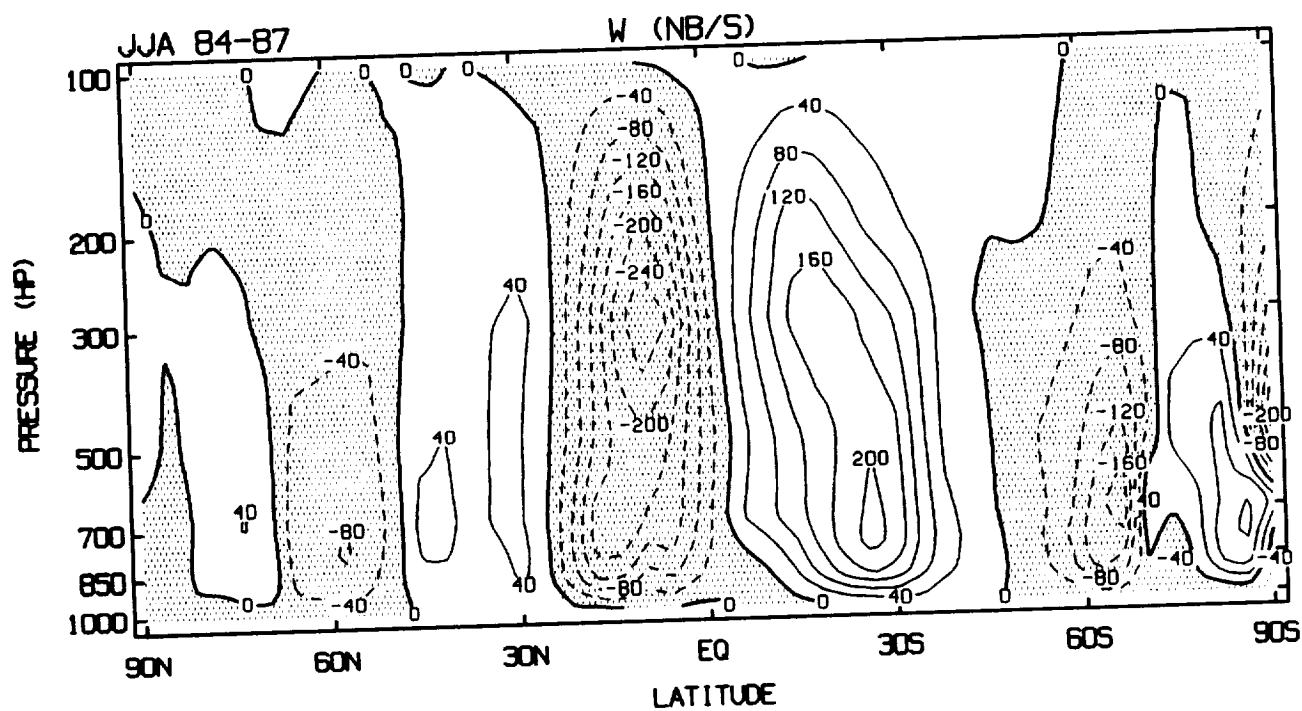
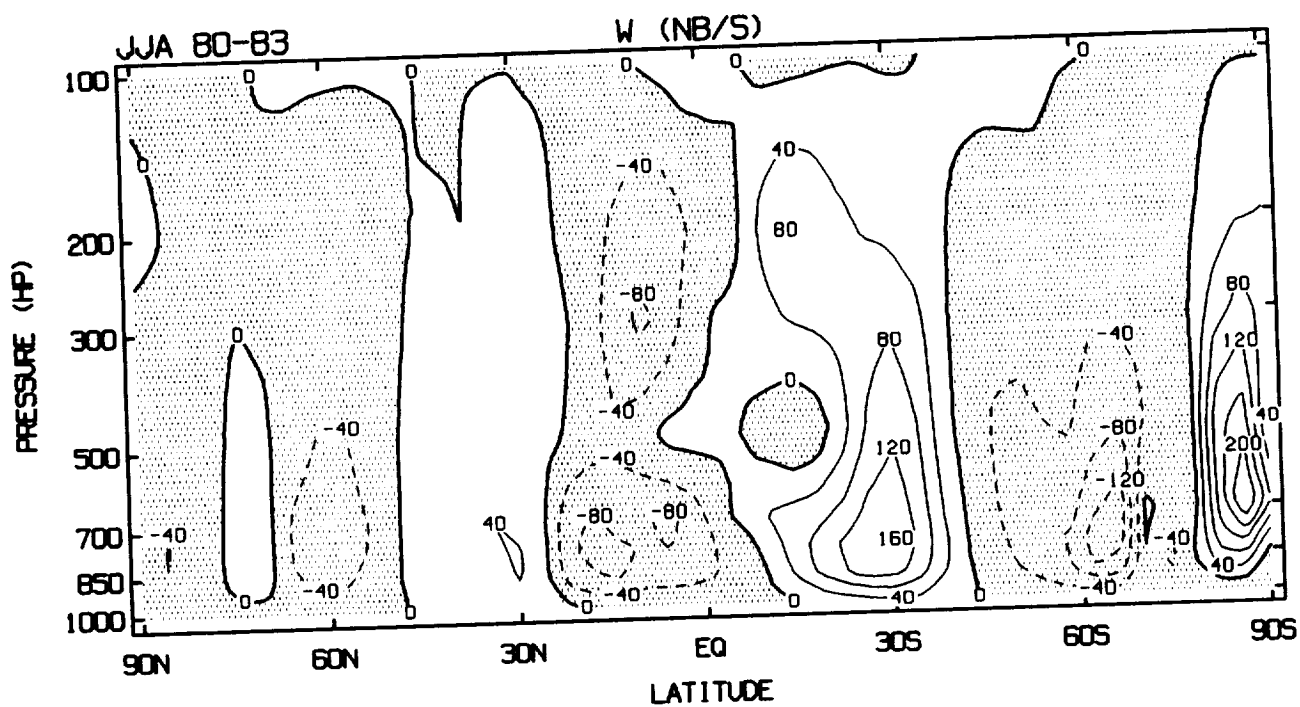


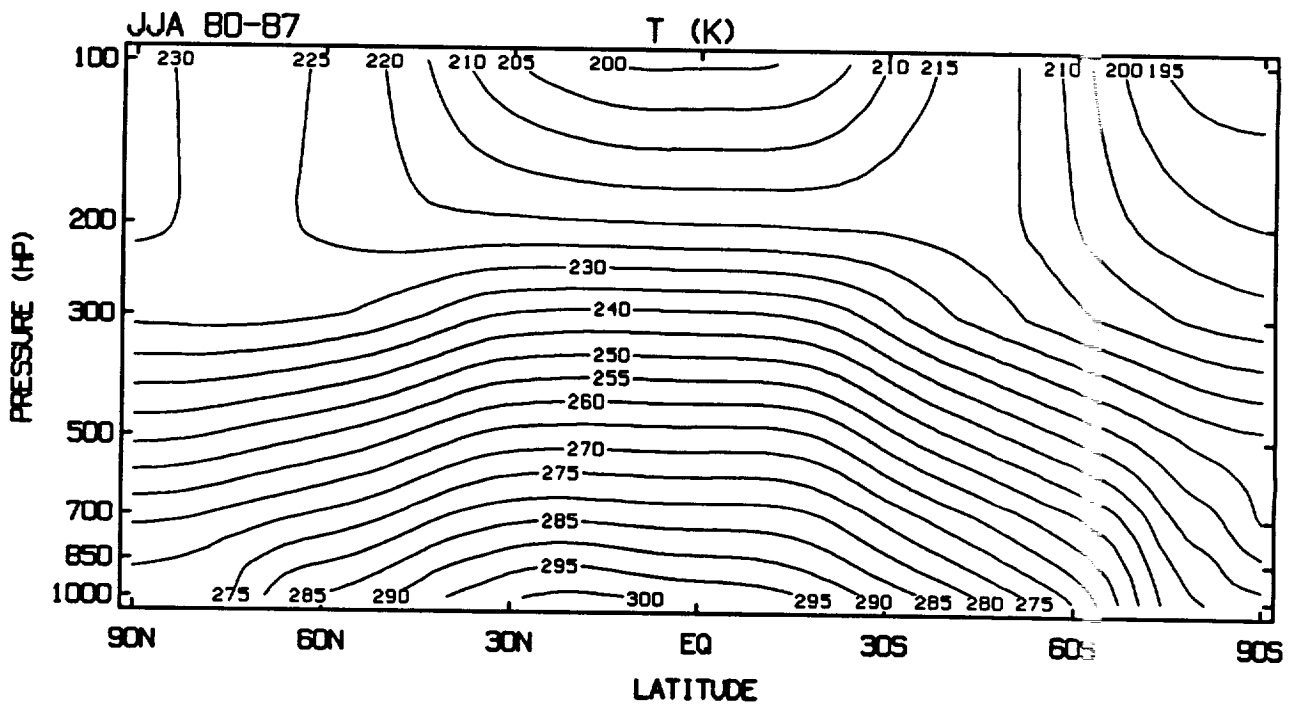
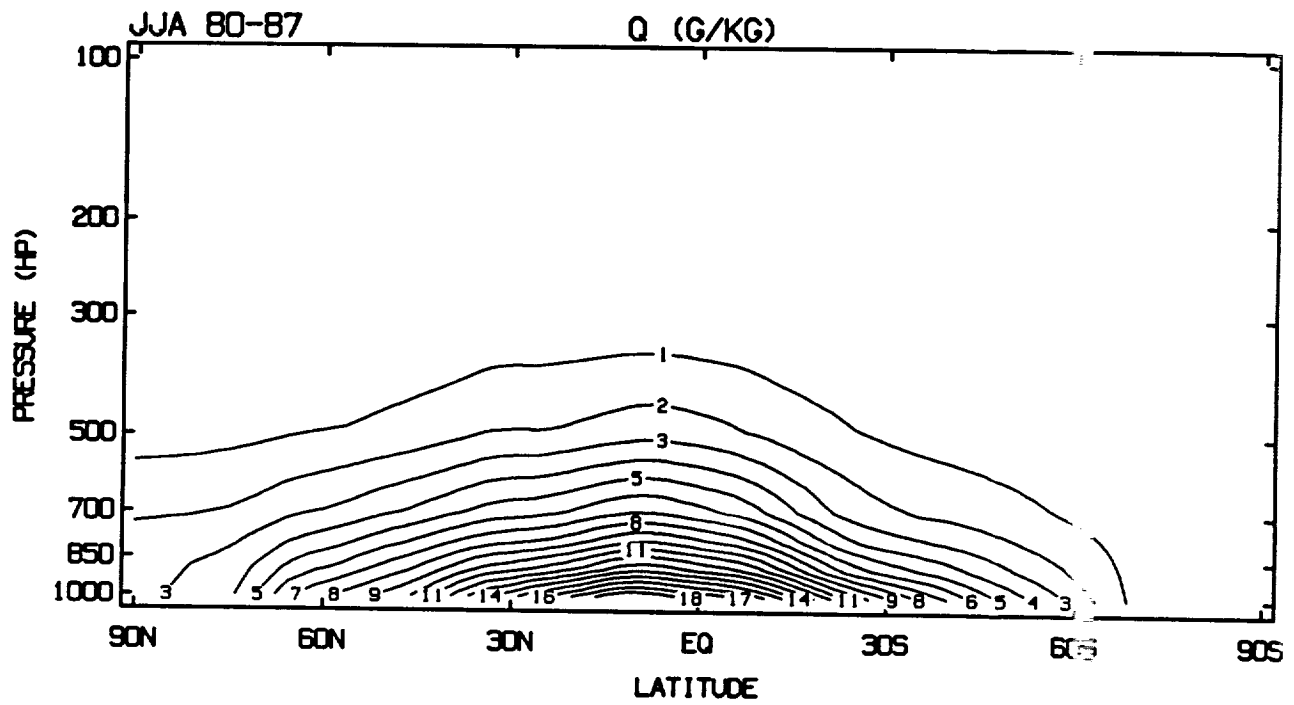




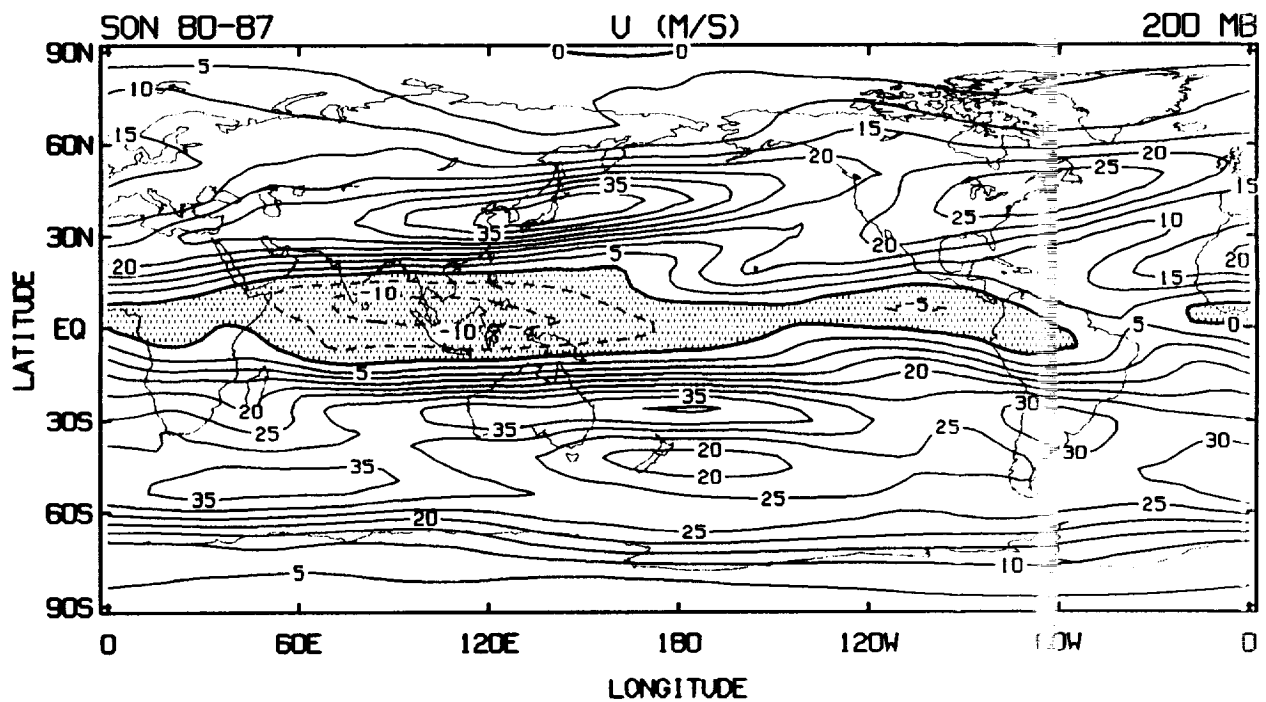
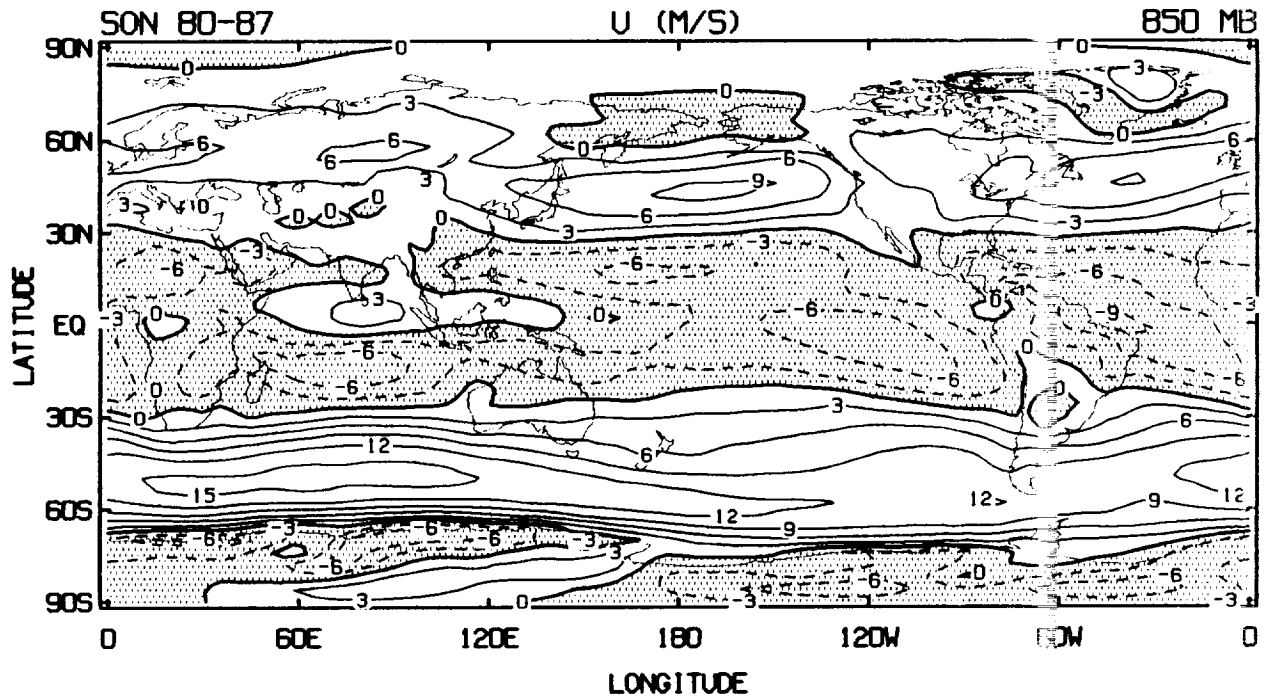


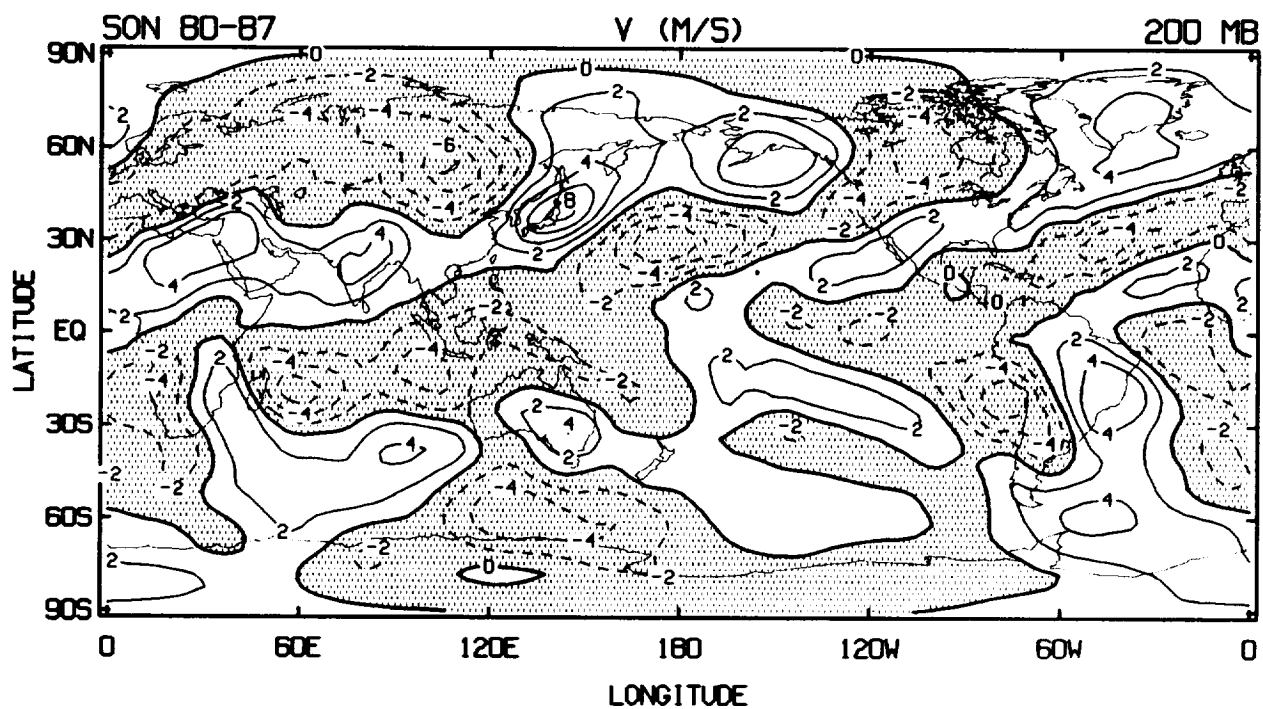
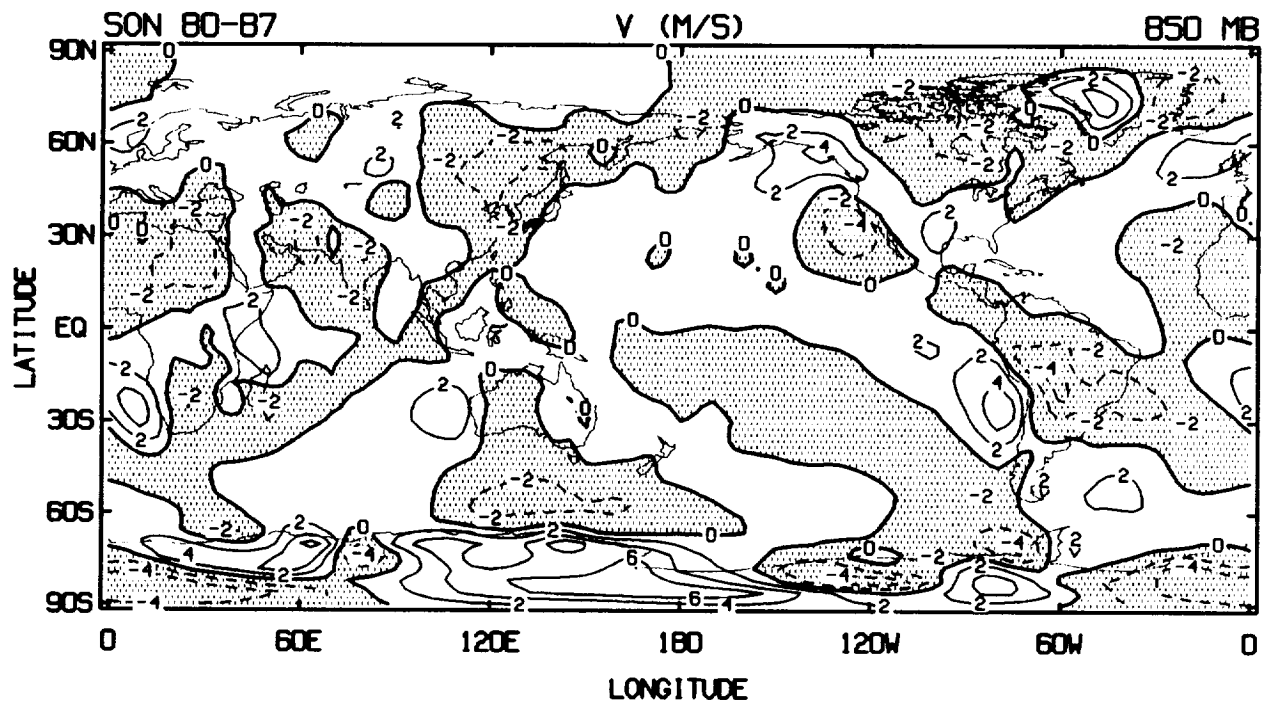


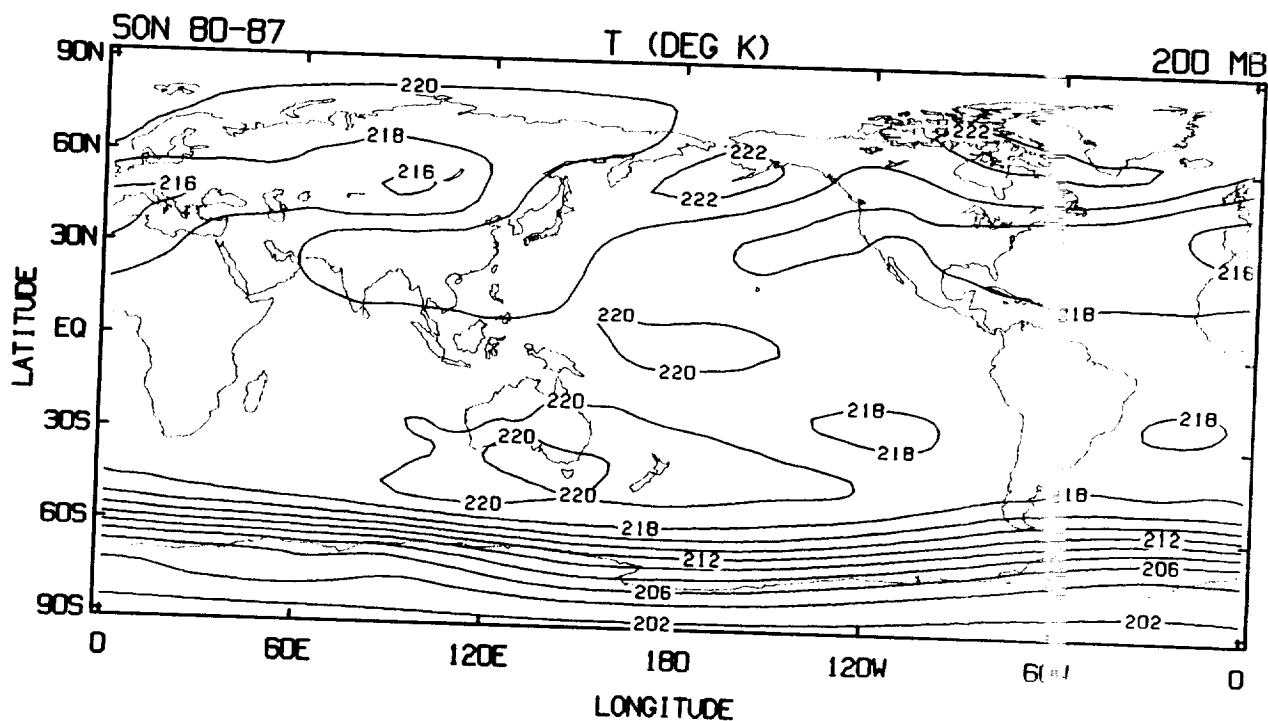
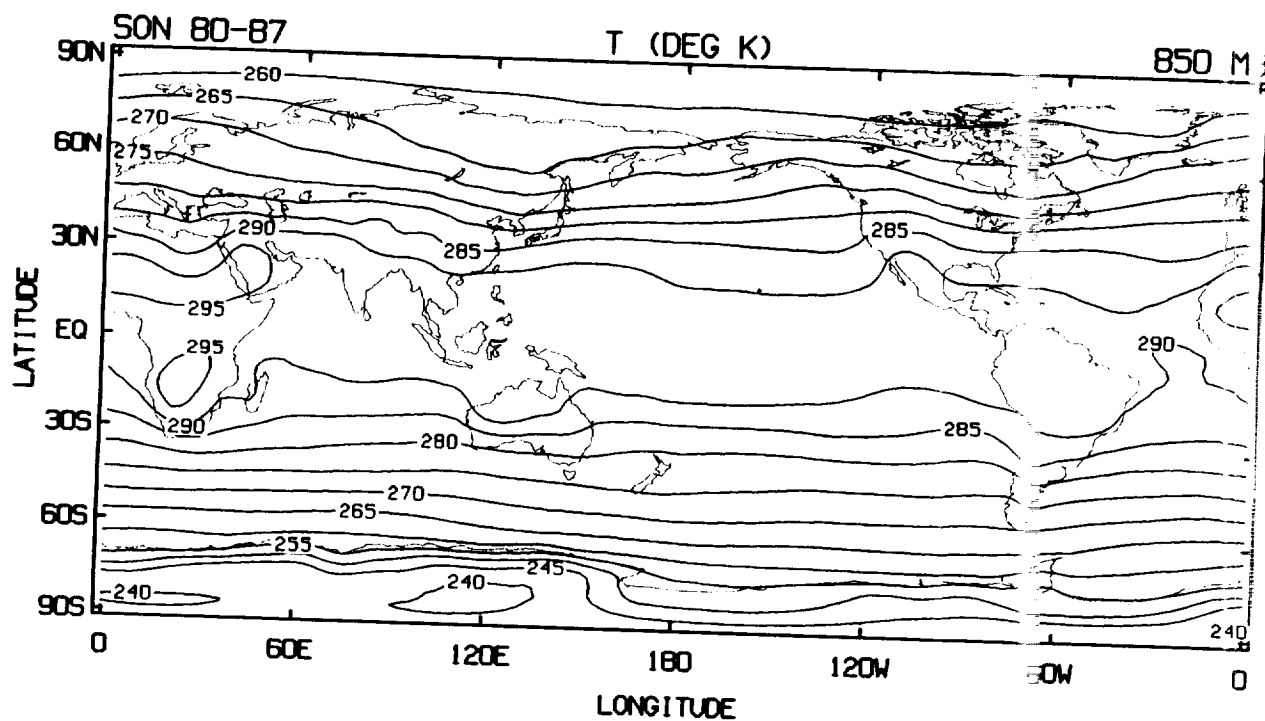


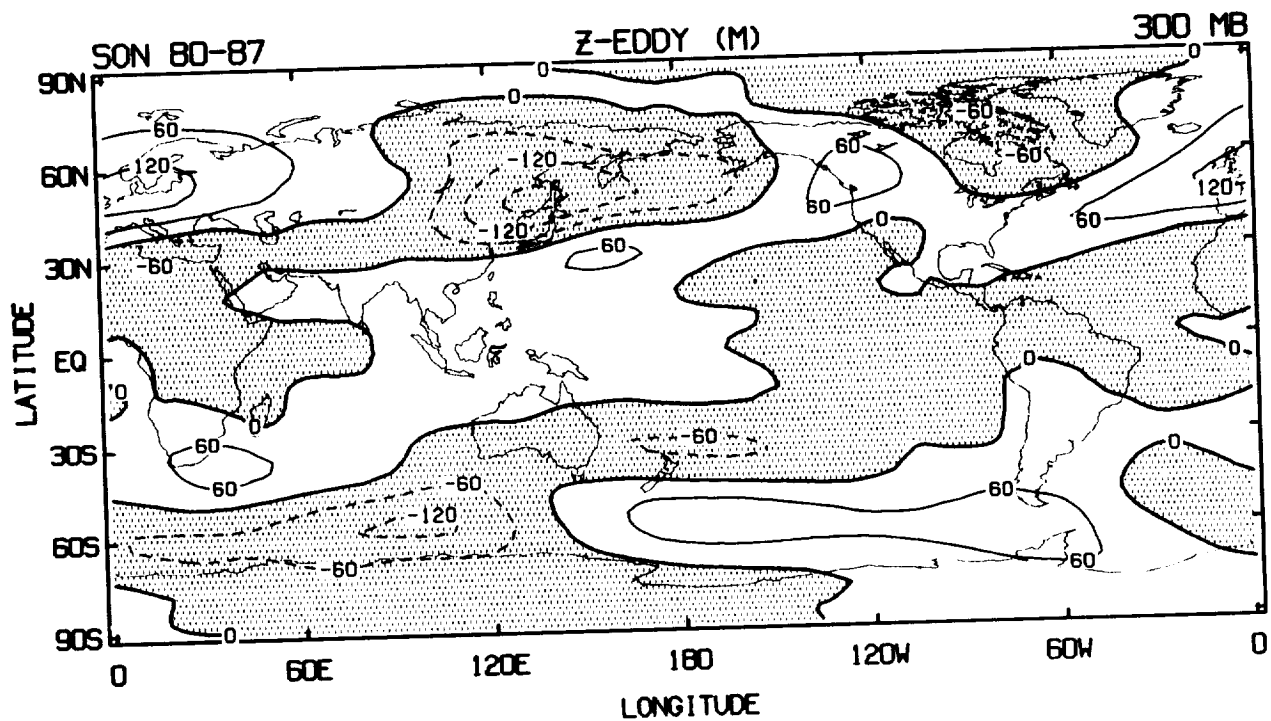
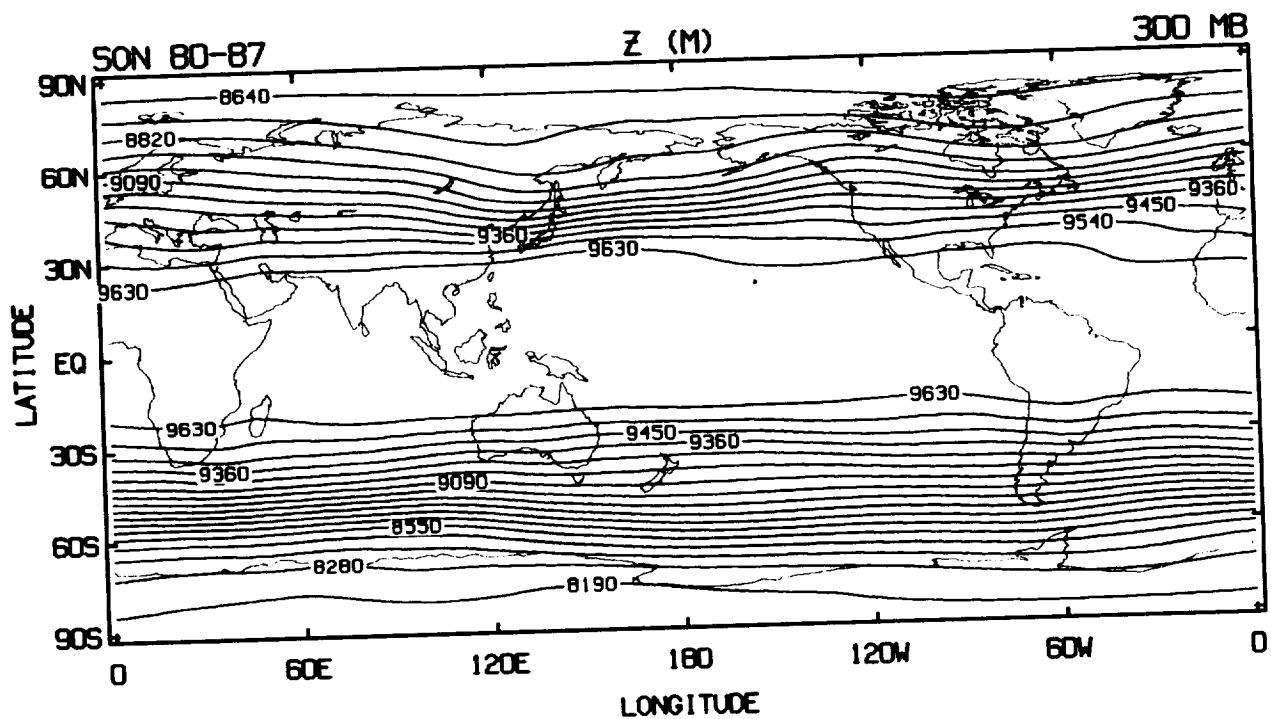


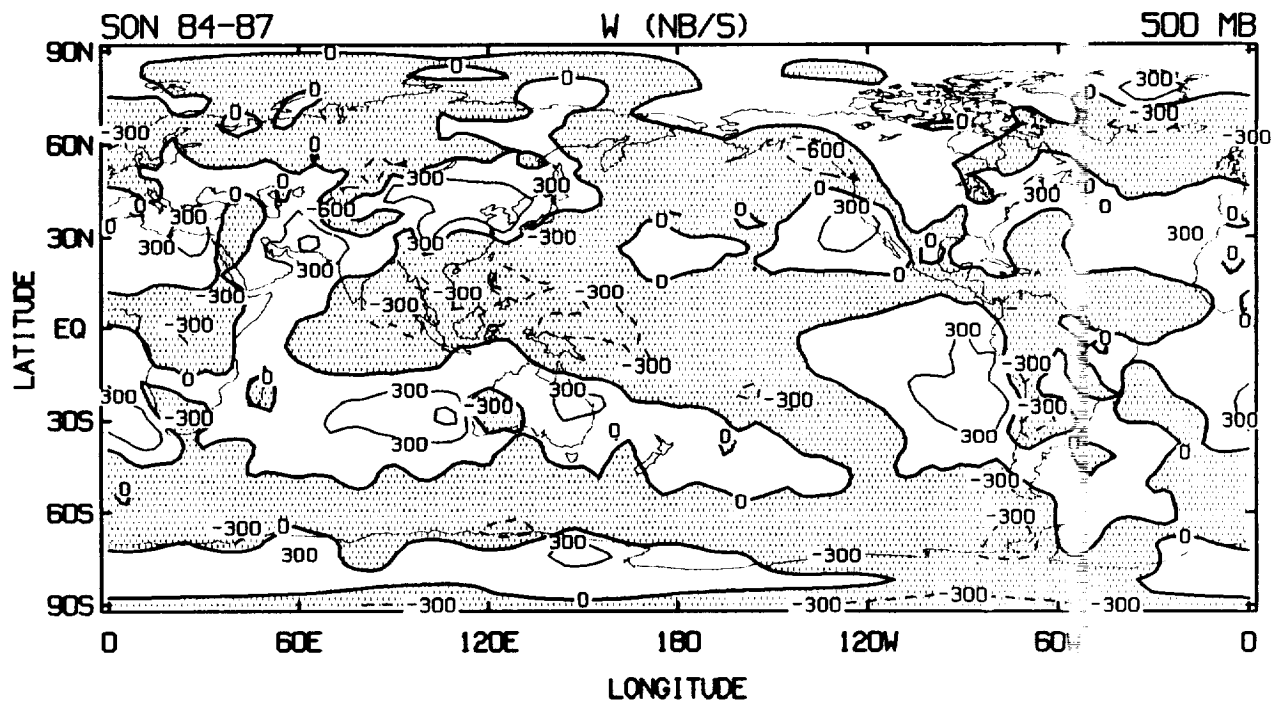
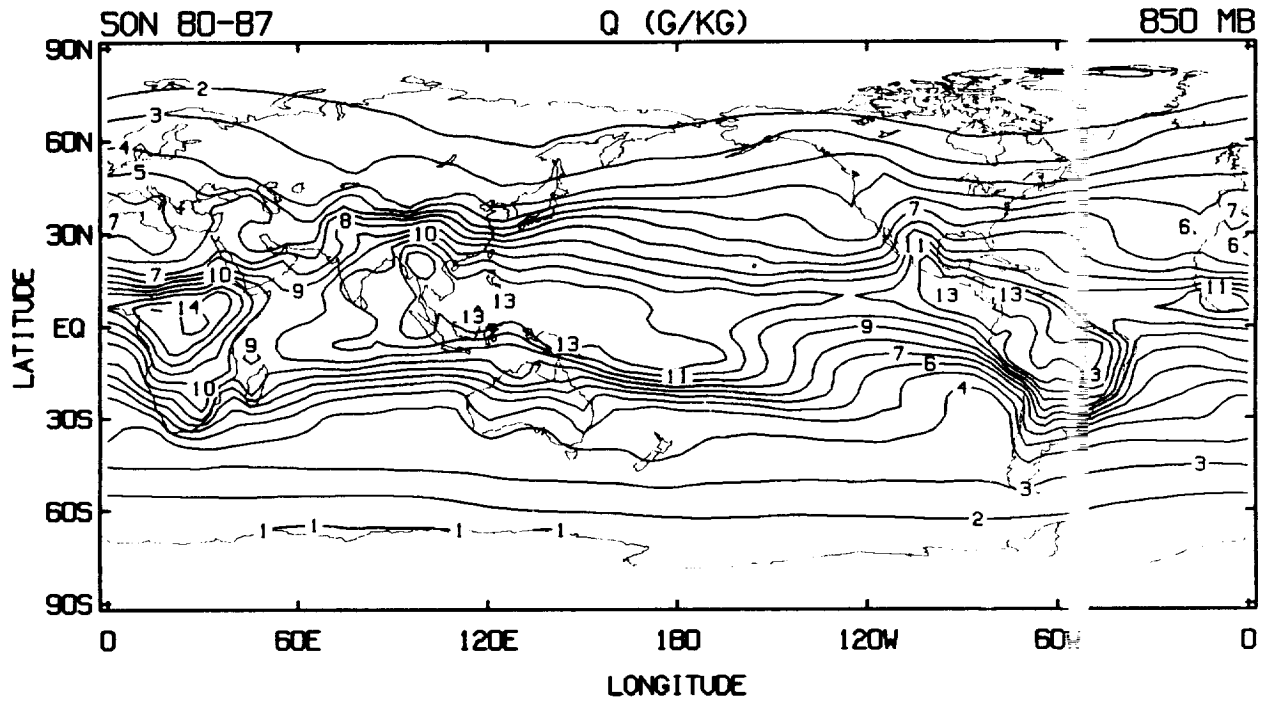
**SEPTEMBER
OCTOBER
NOVEMBER**

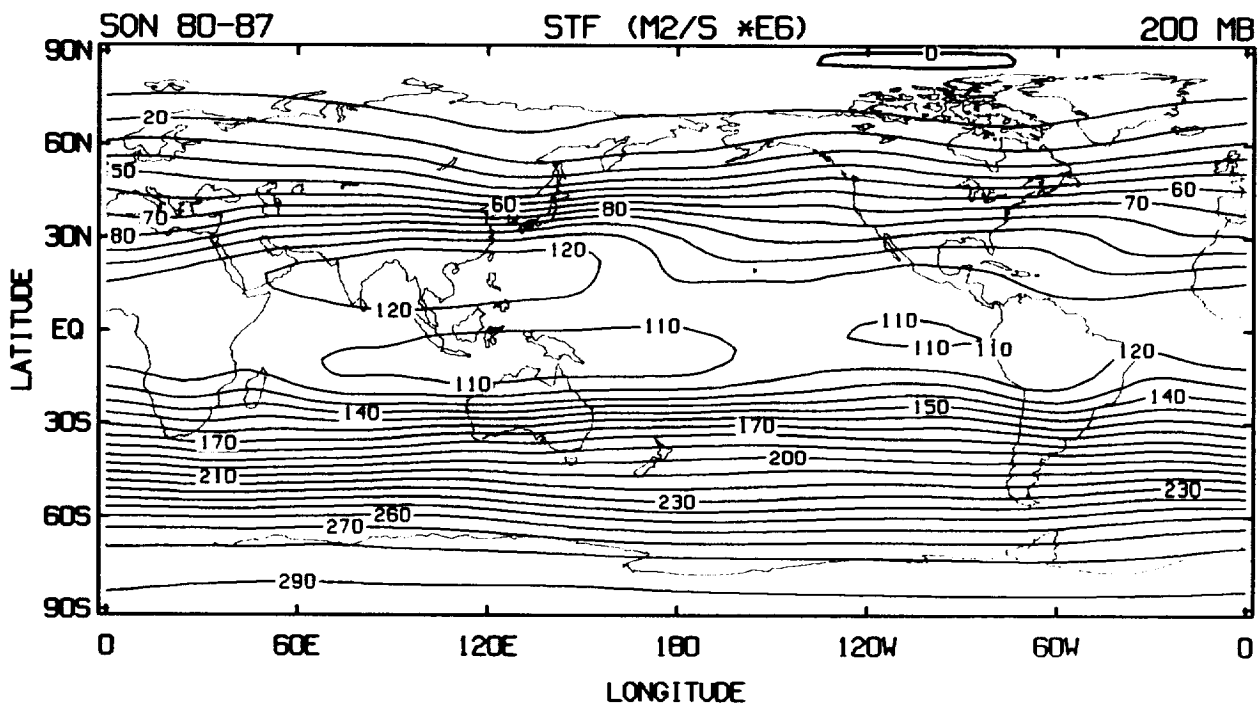
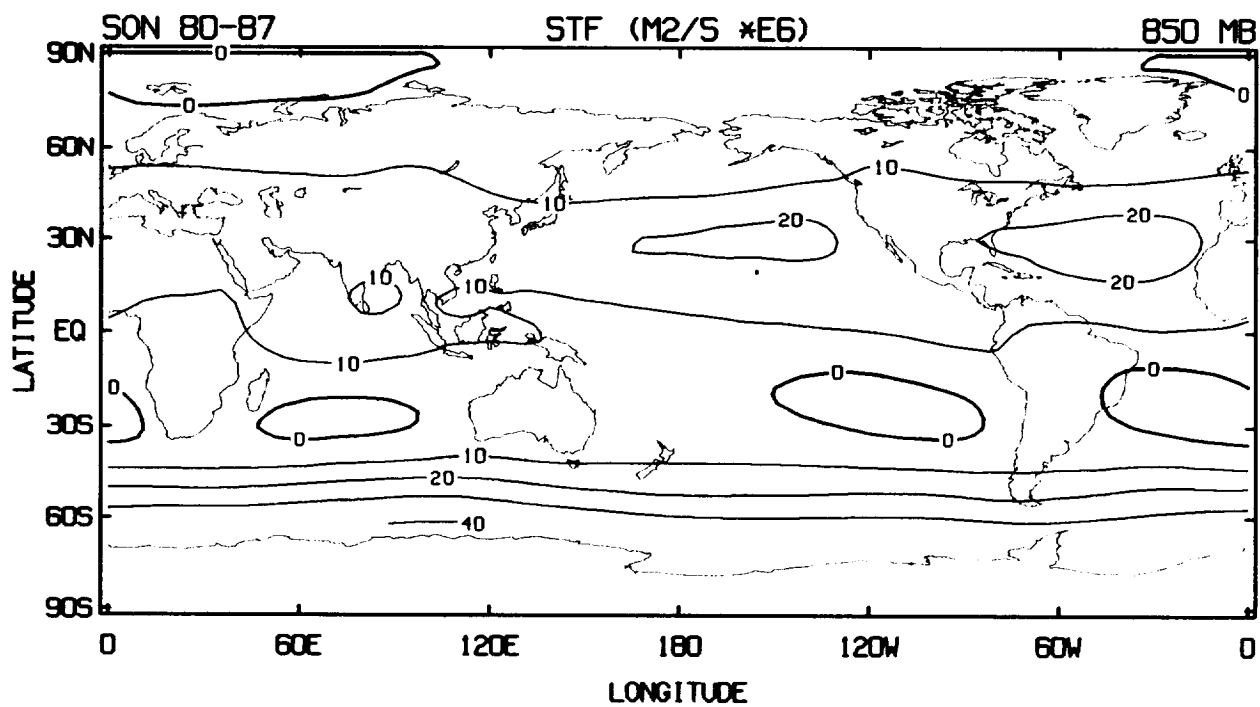


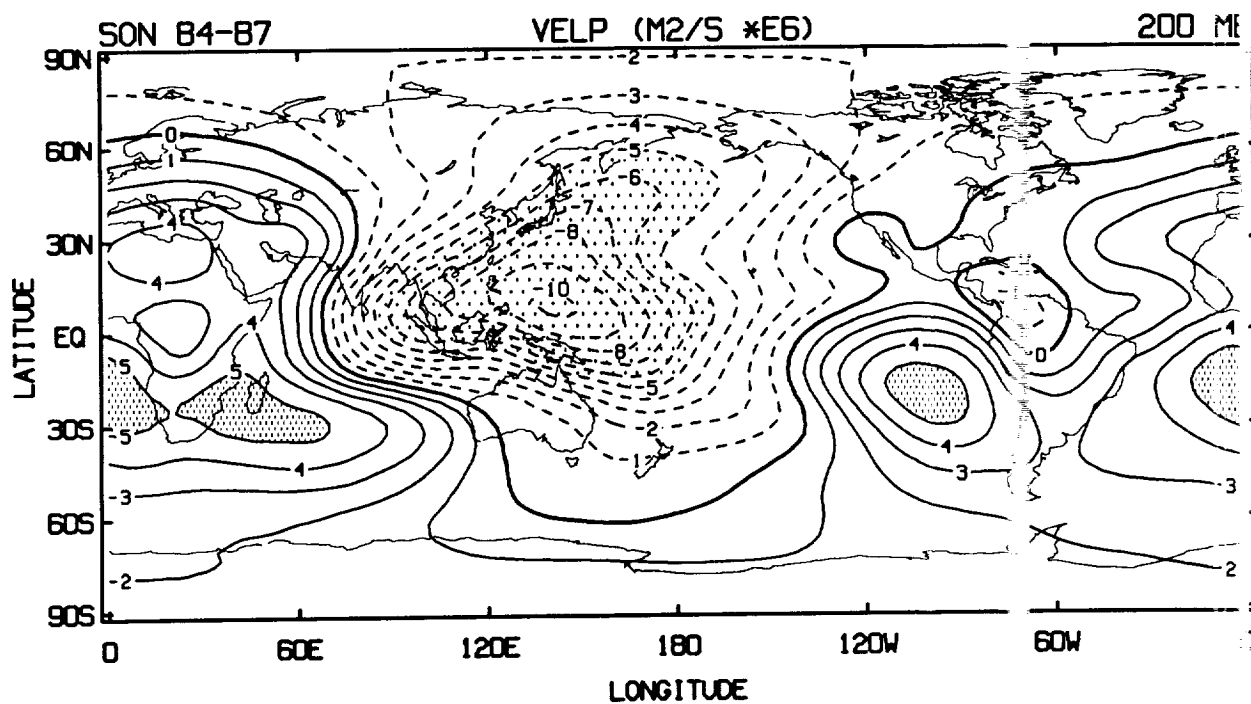
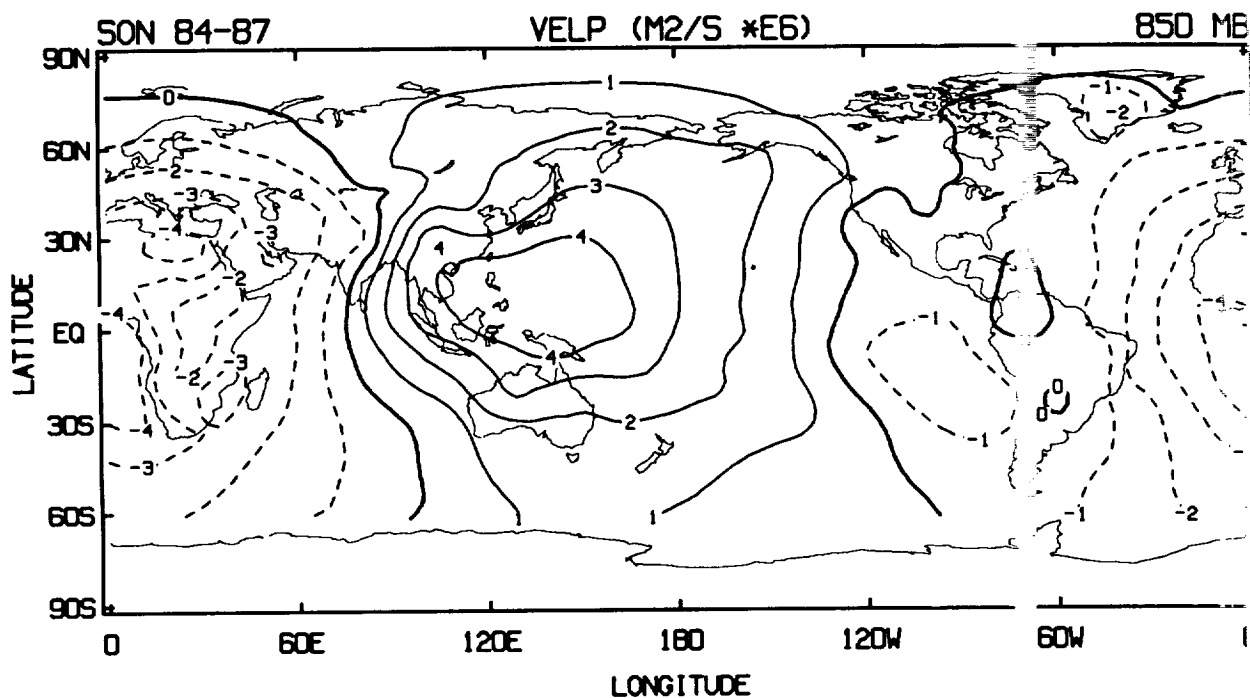


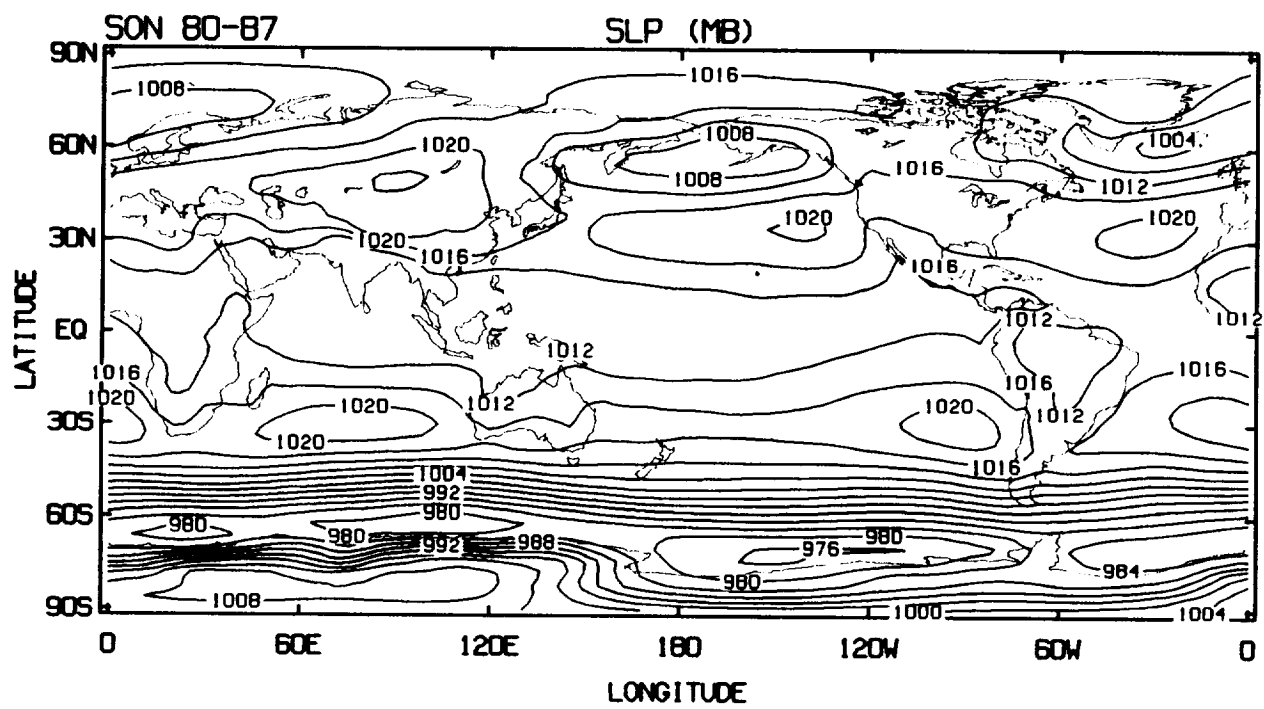


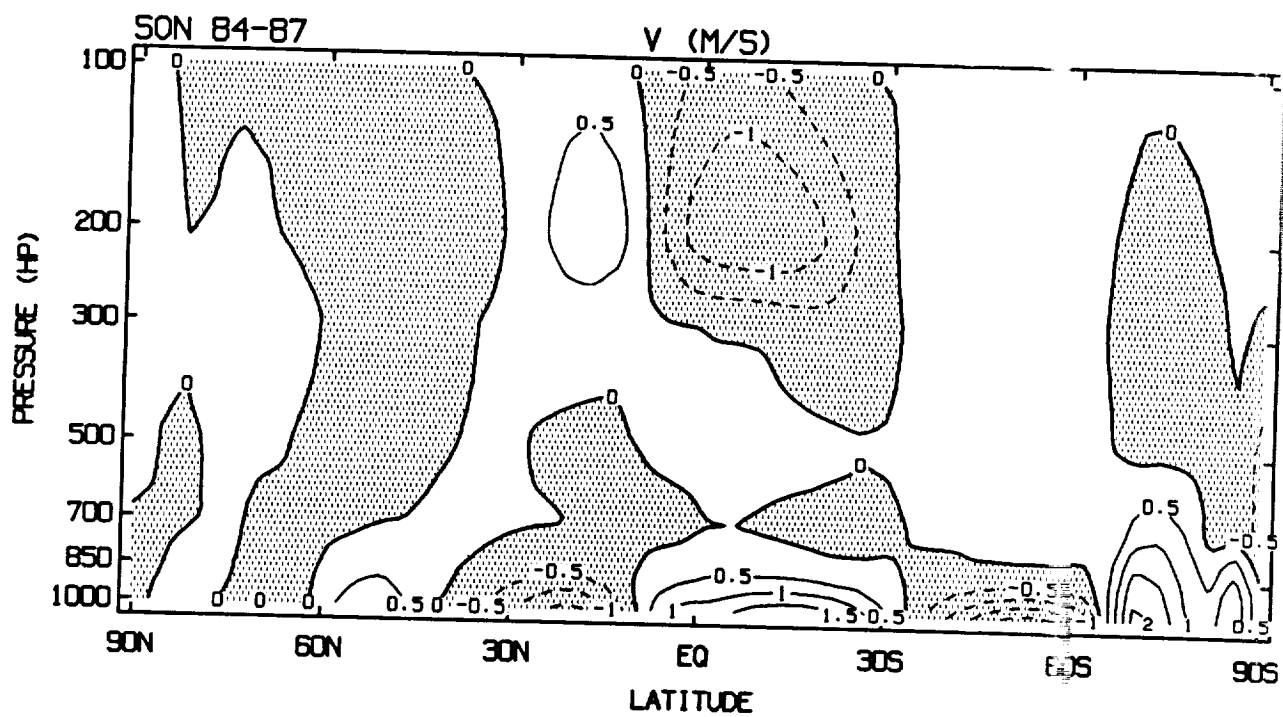
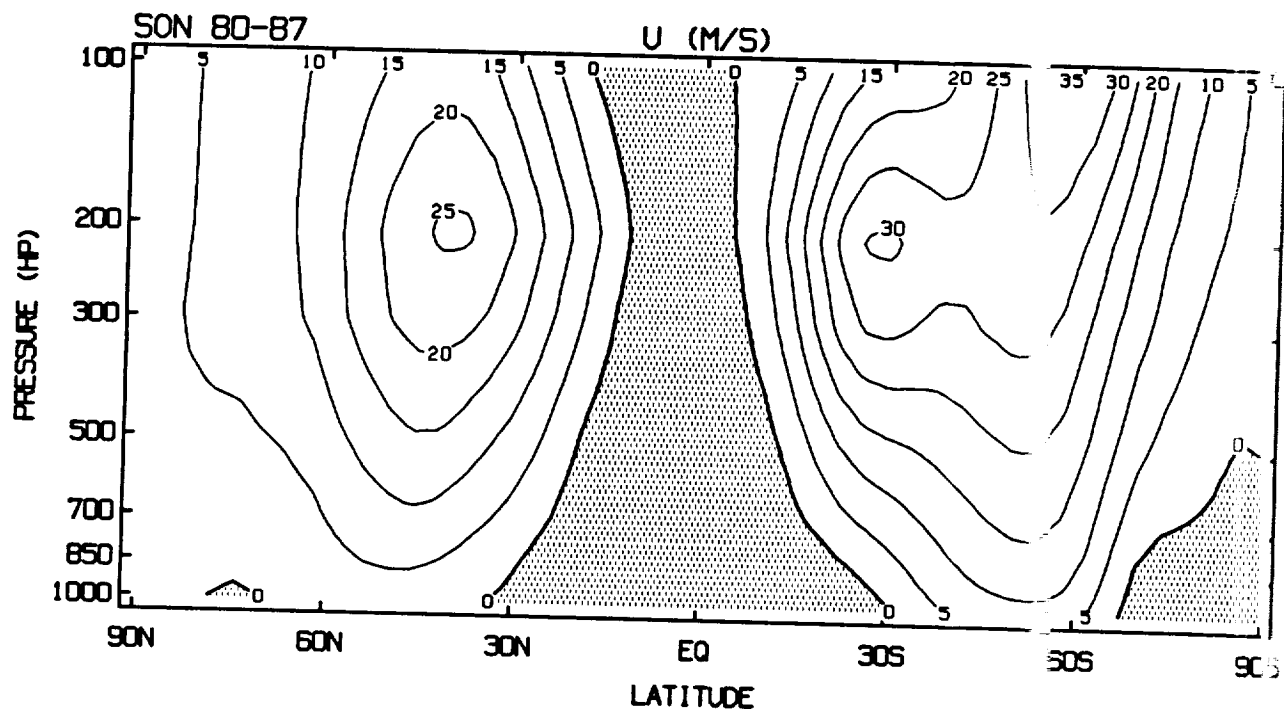


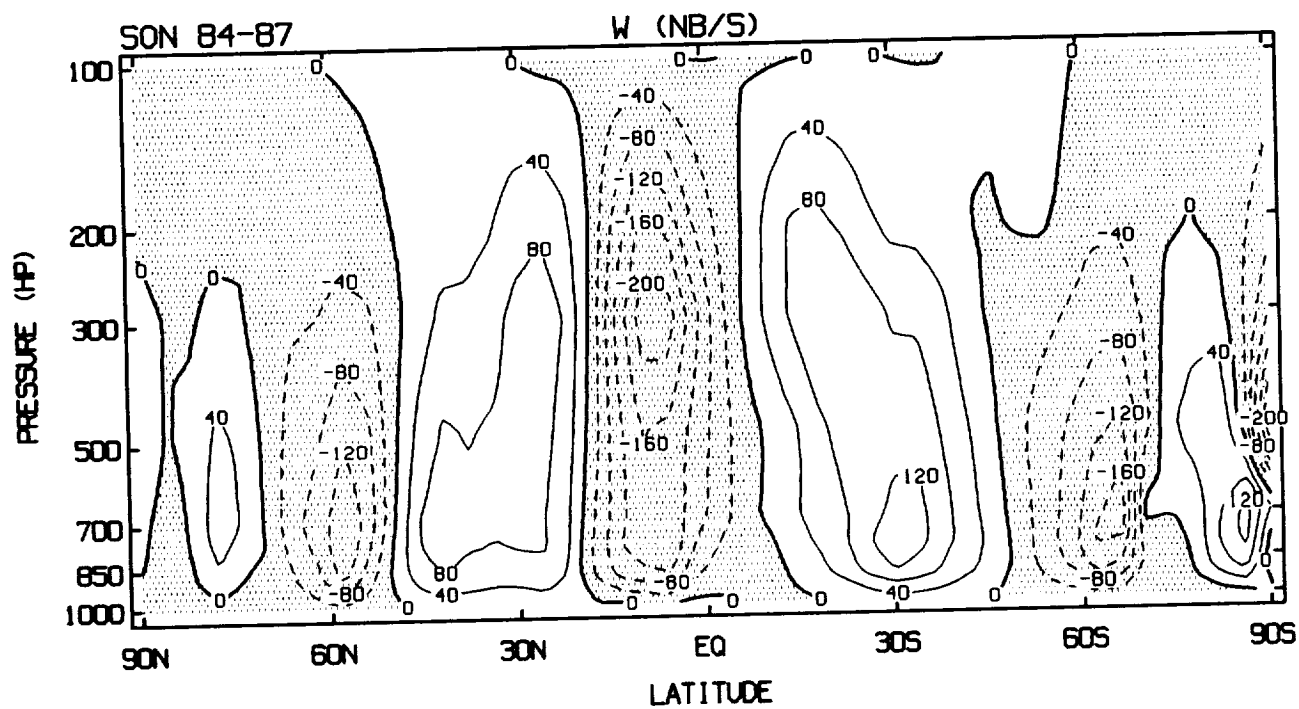
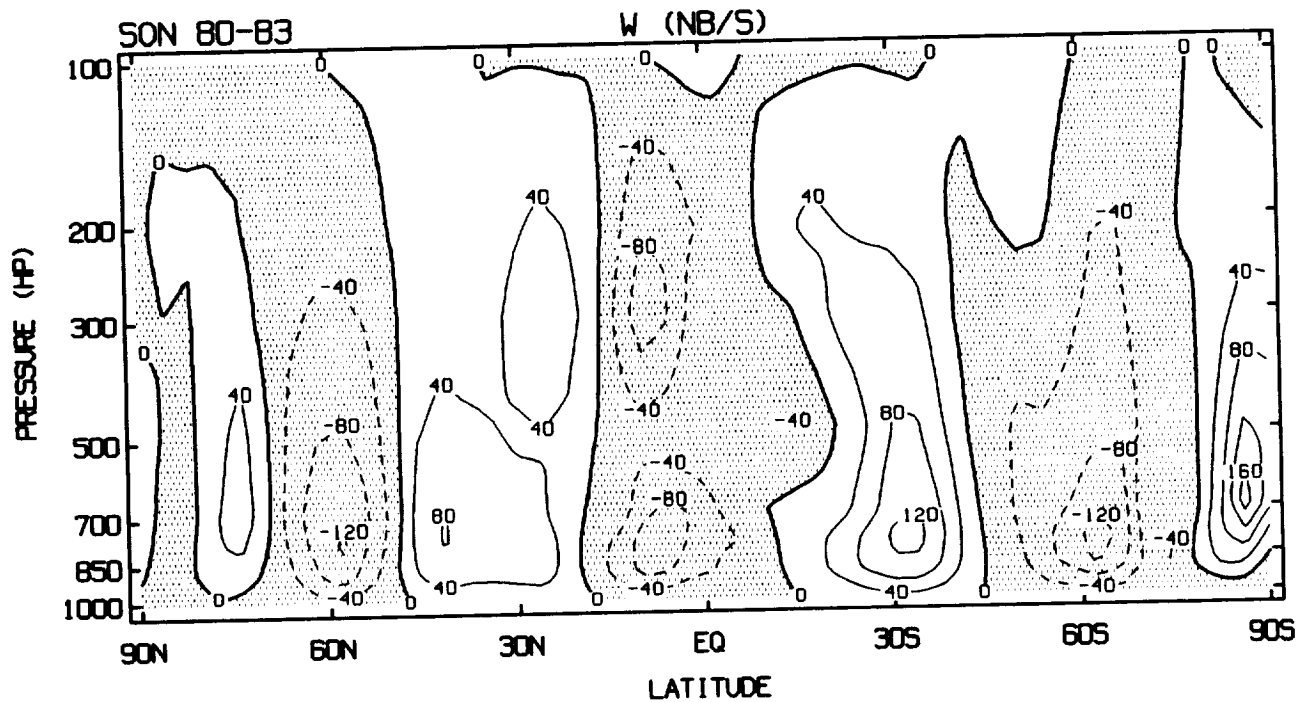


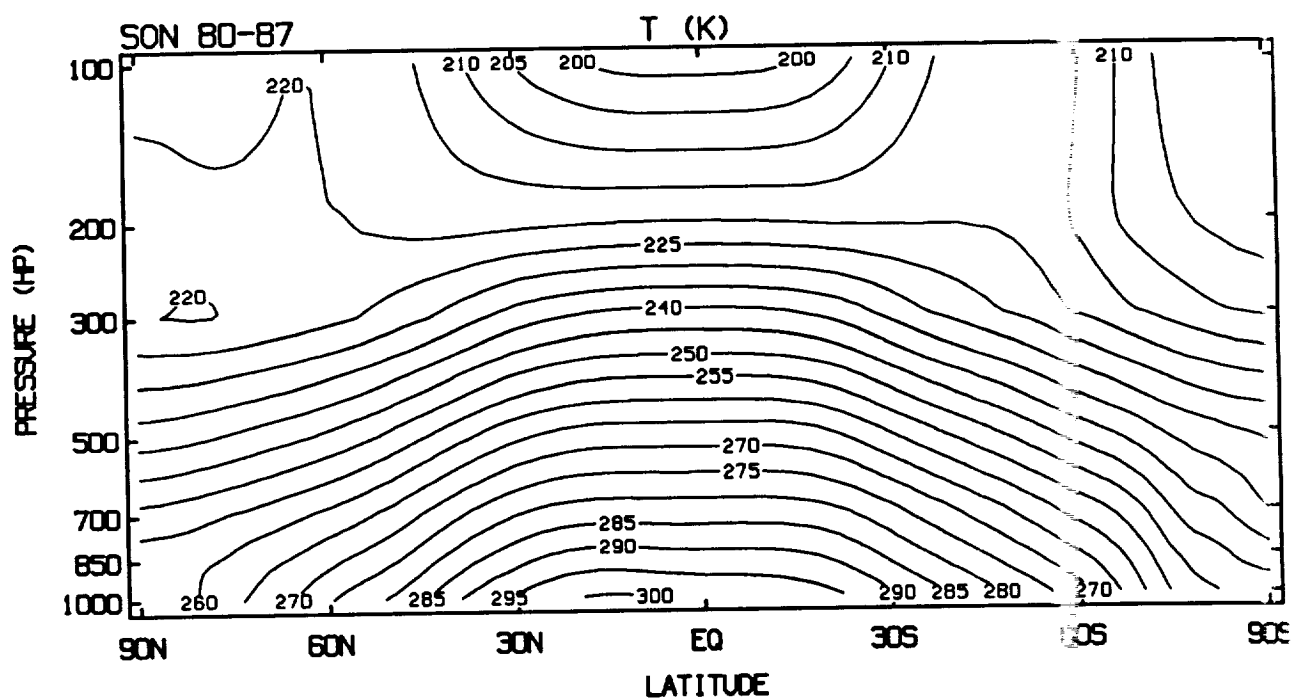
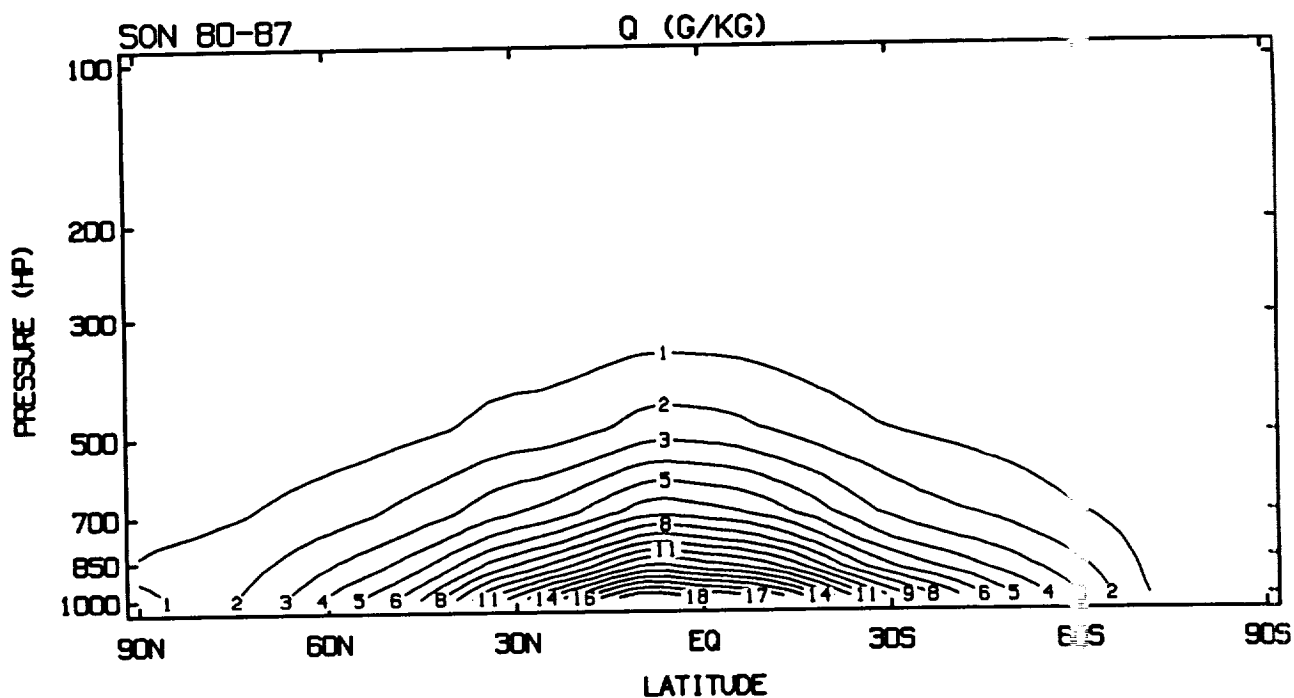




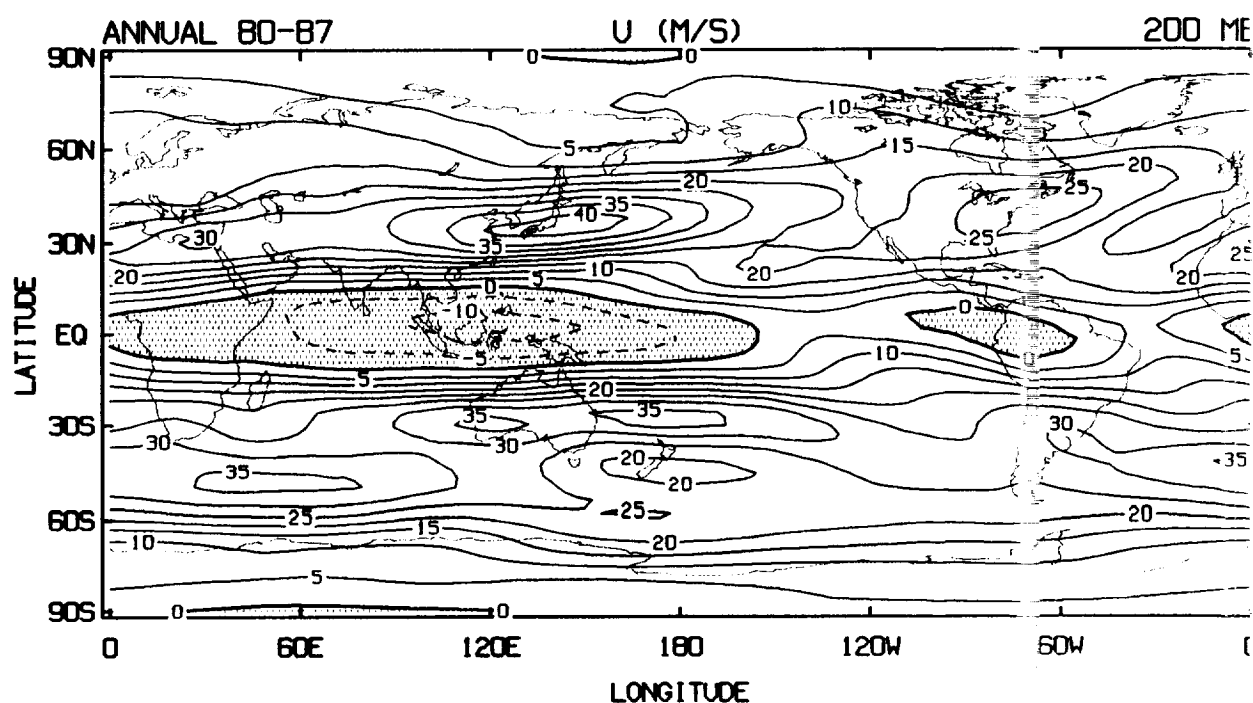
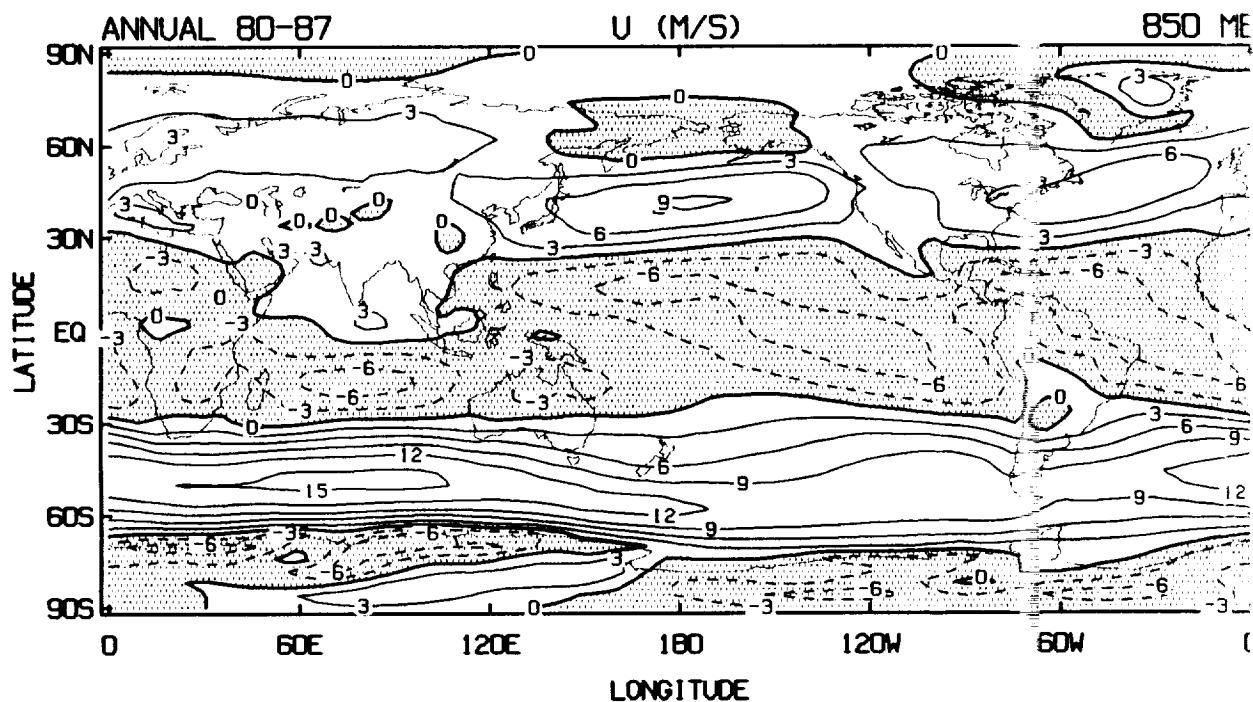


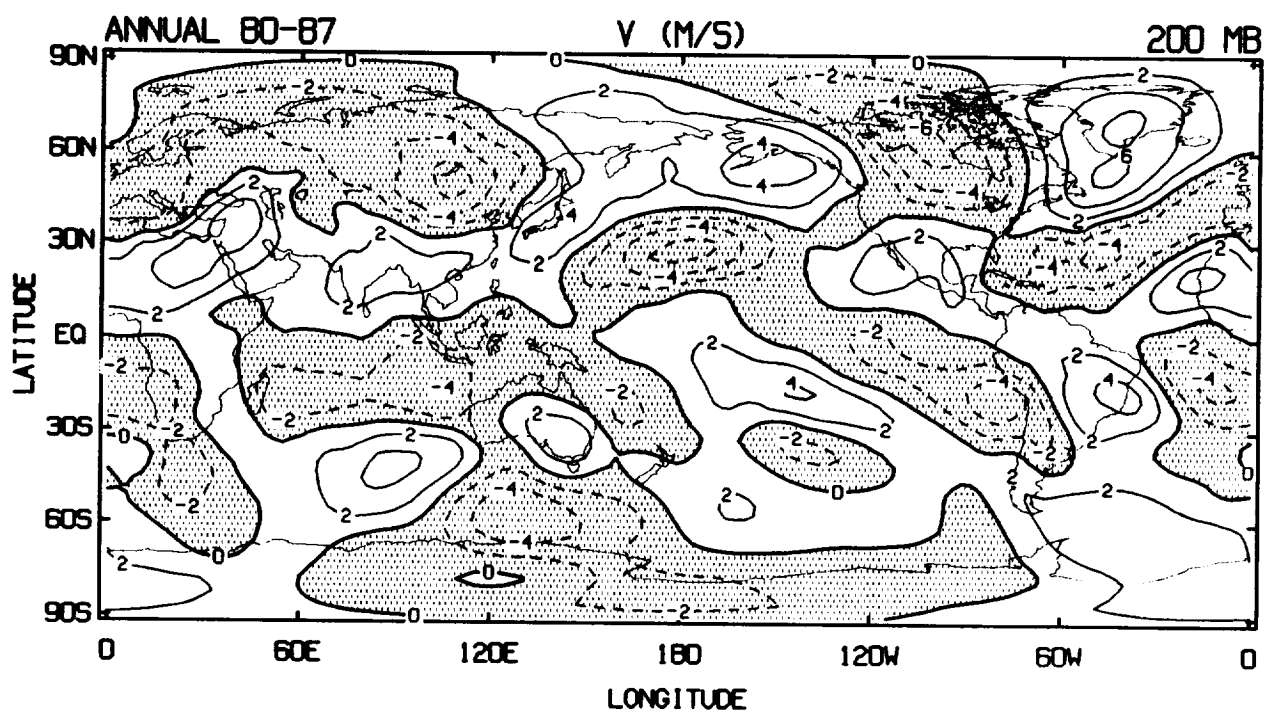
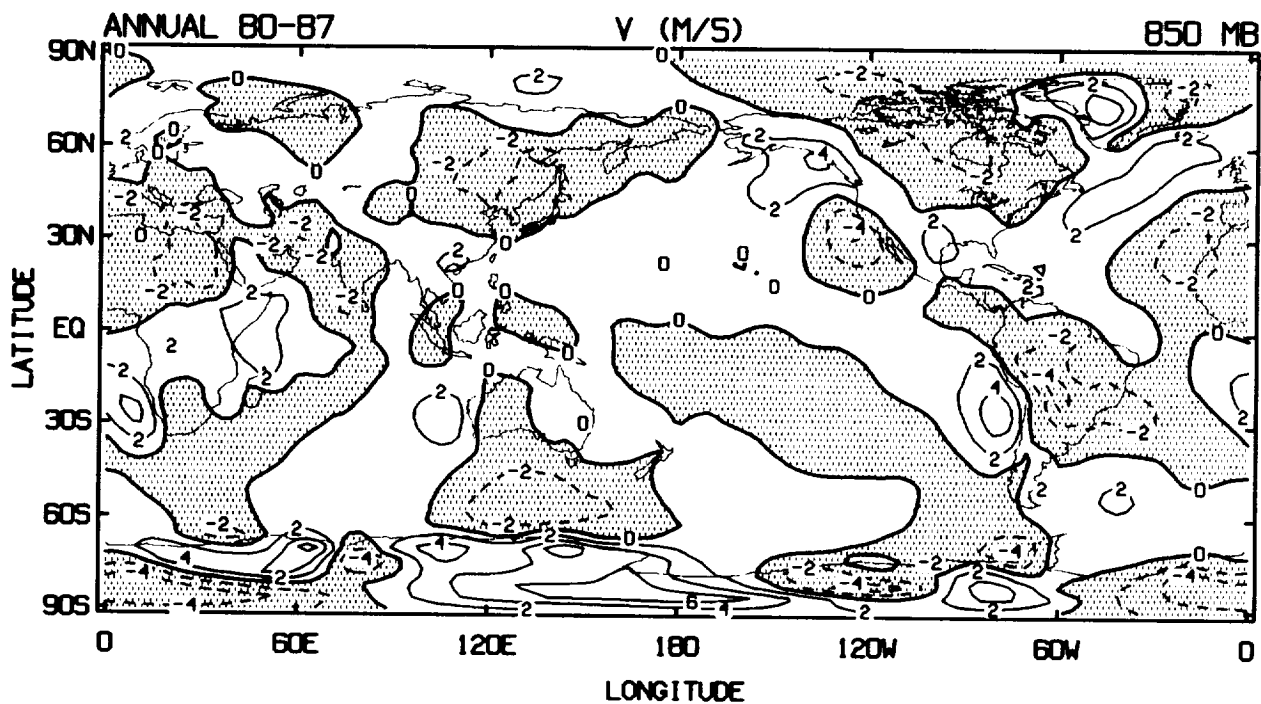


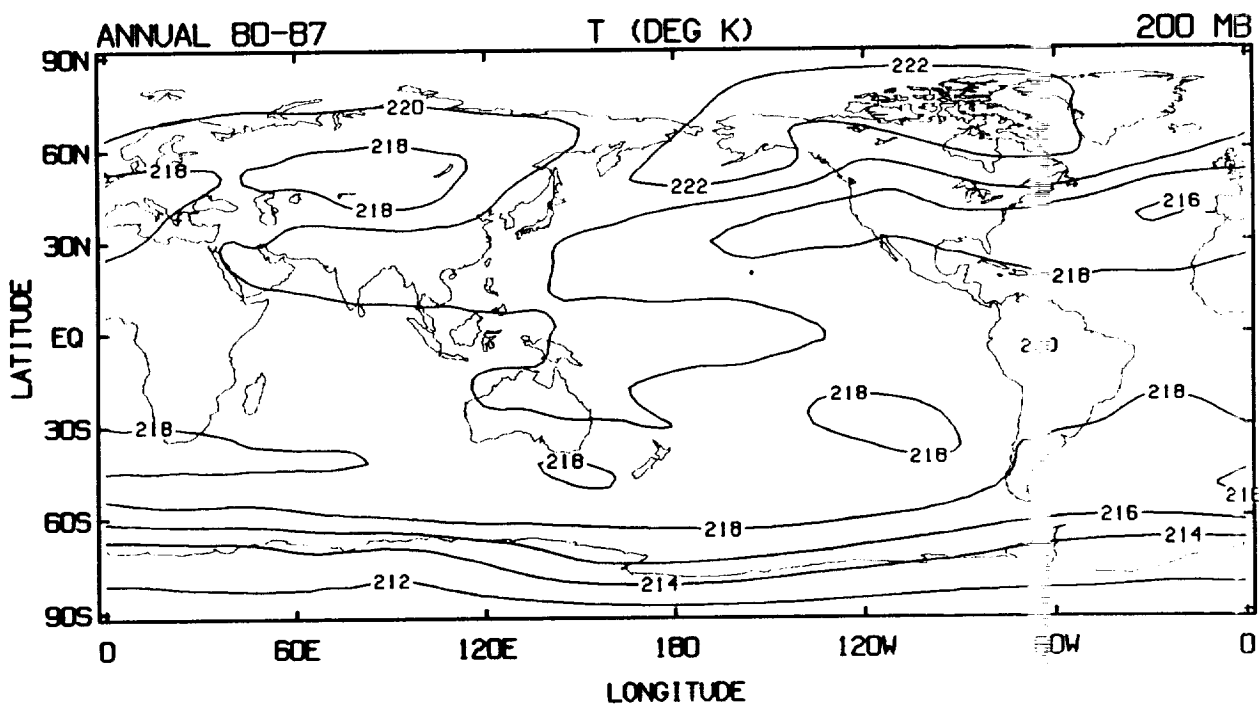
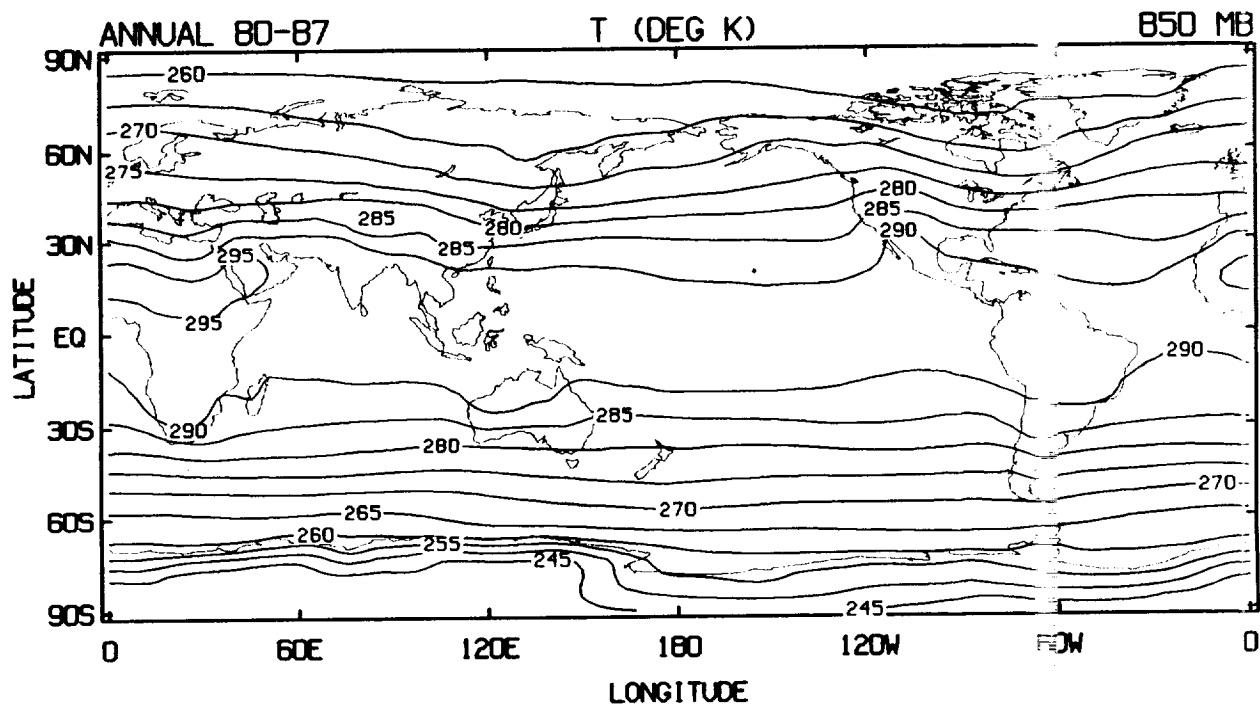


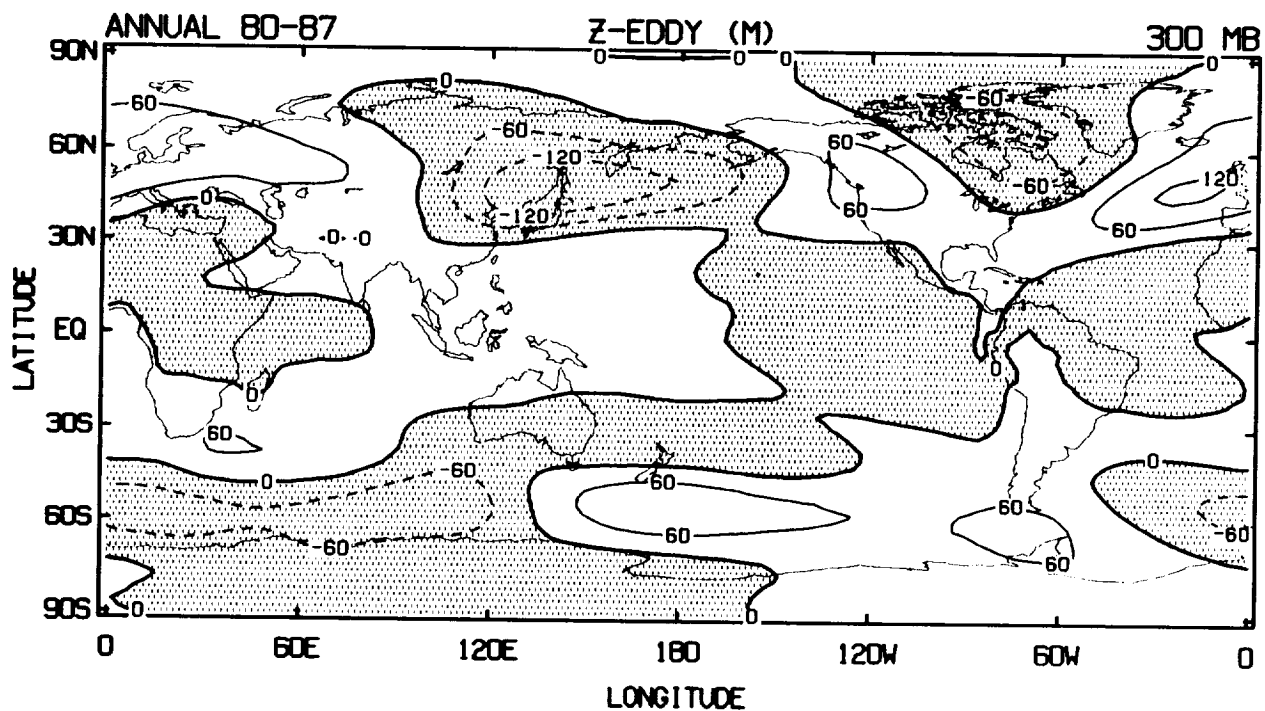
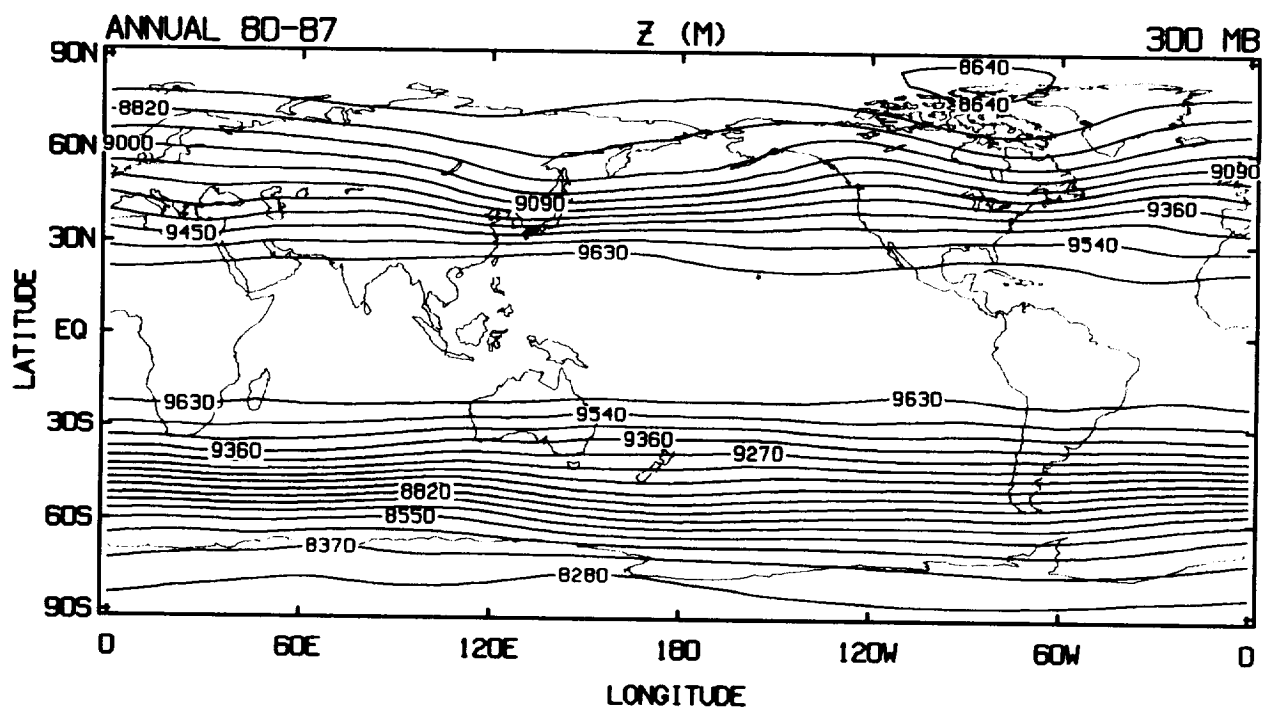


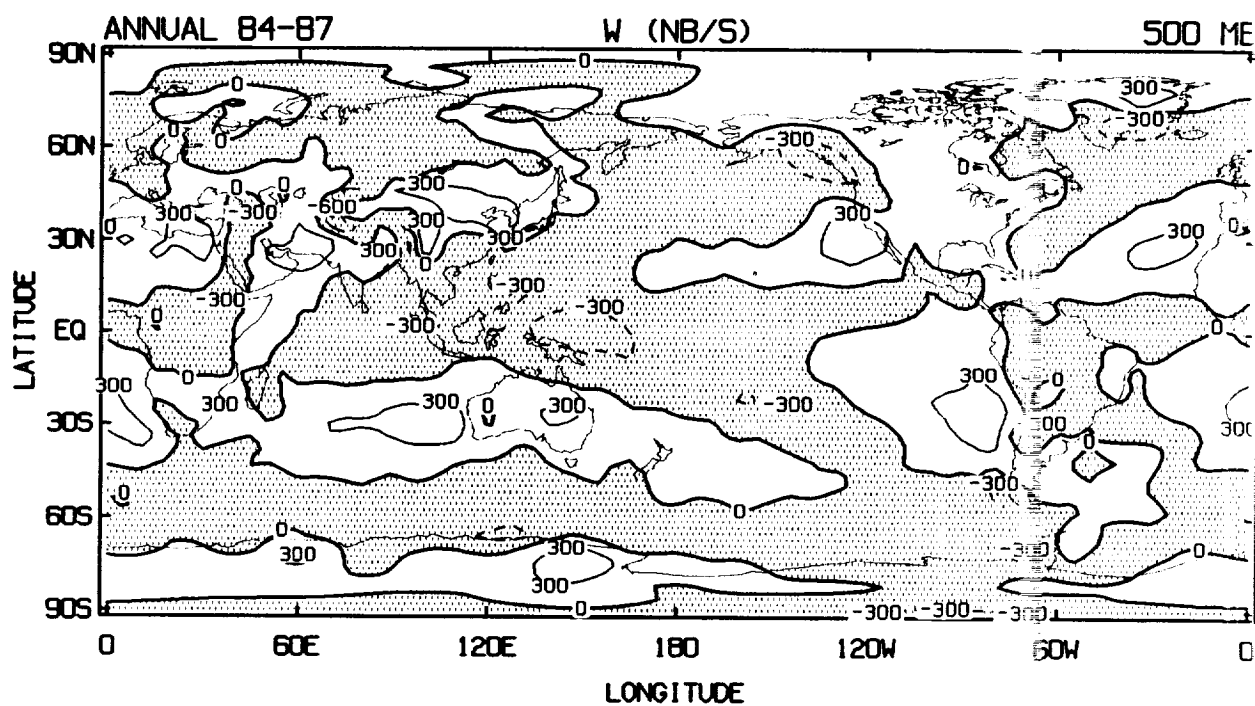
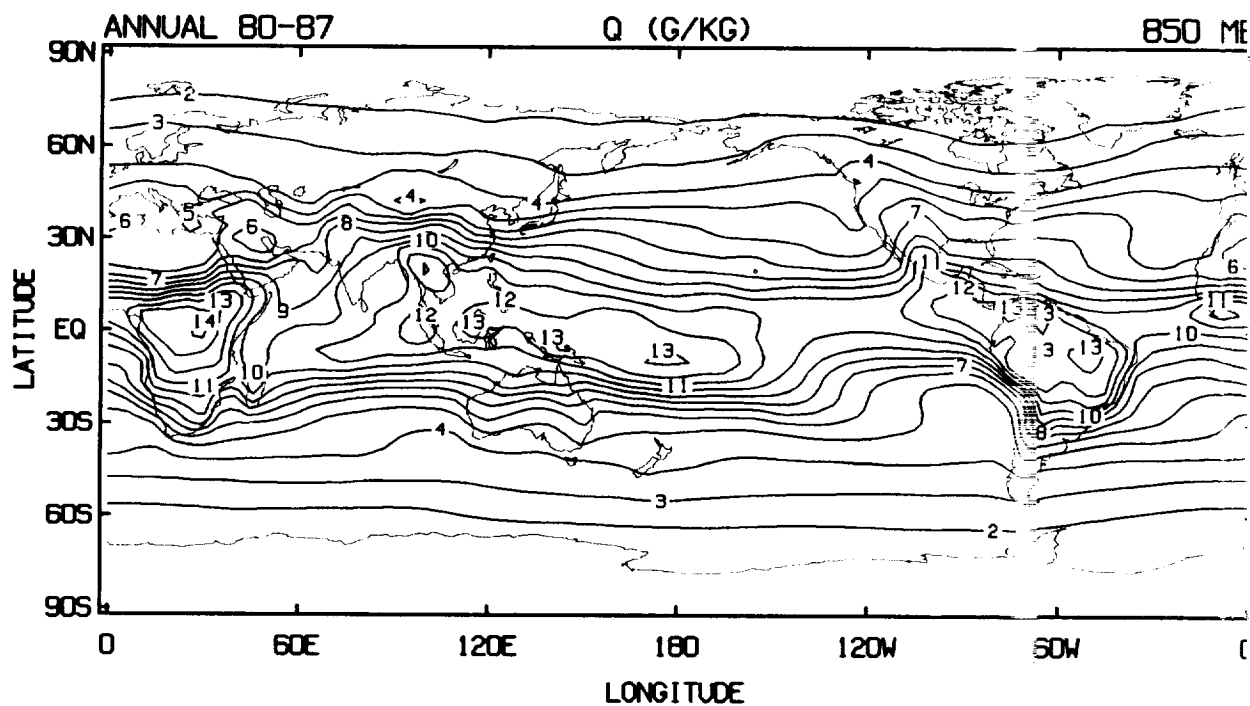
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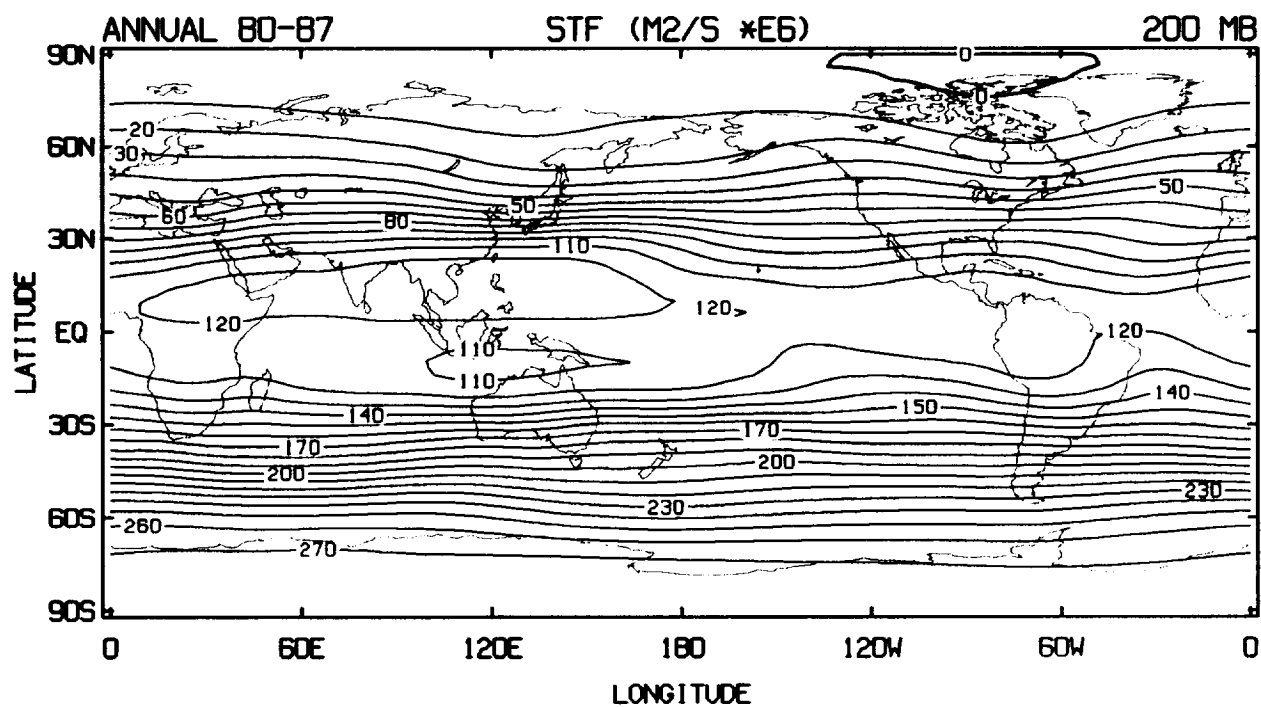
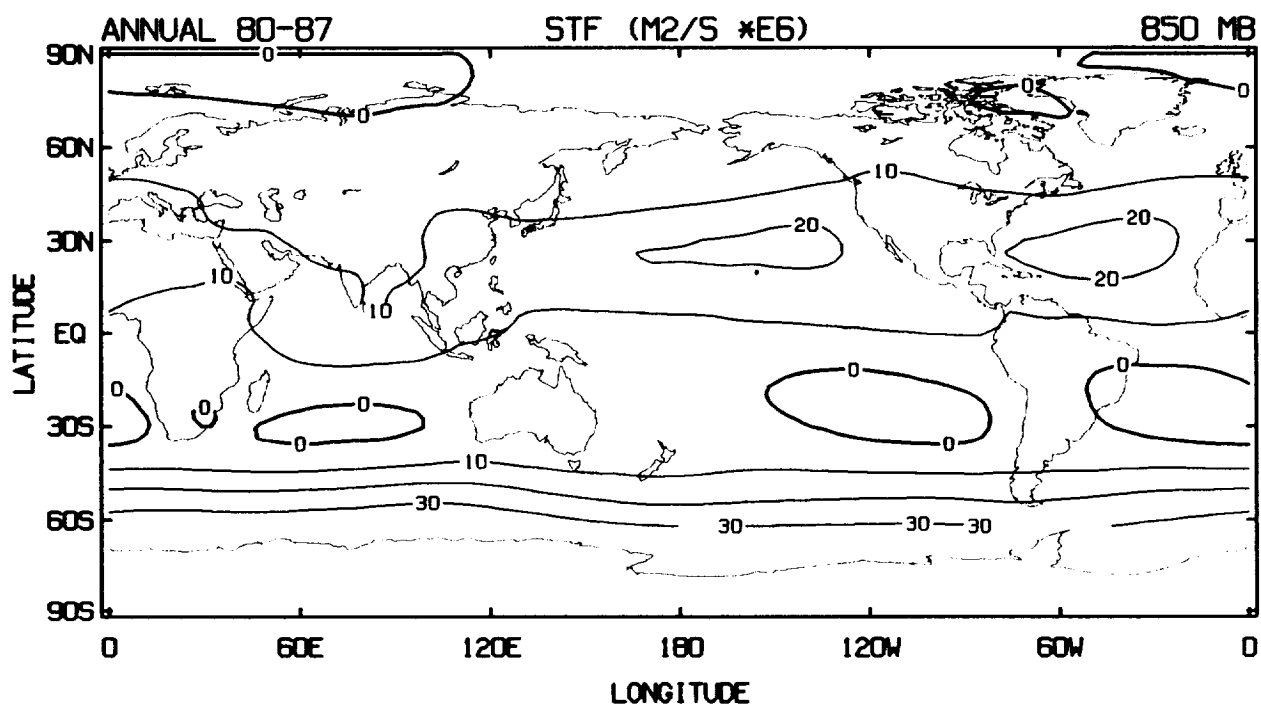


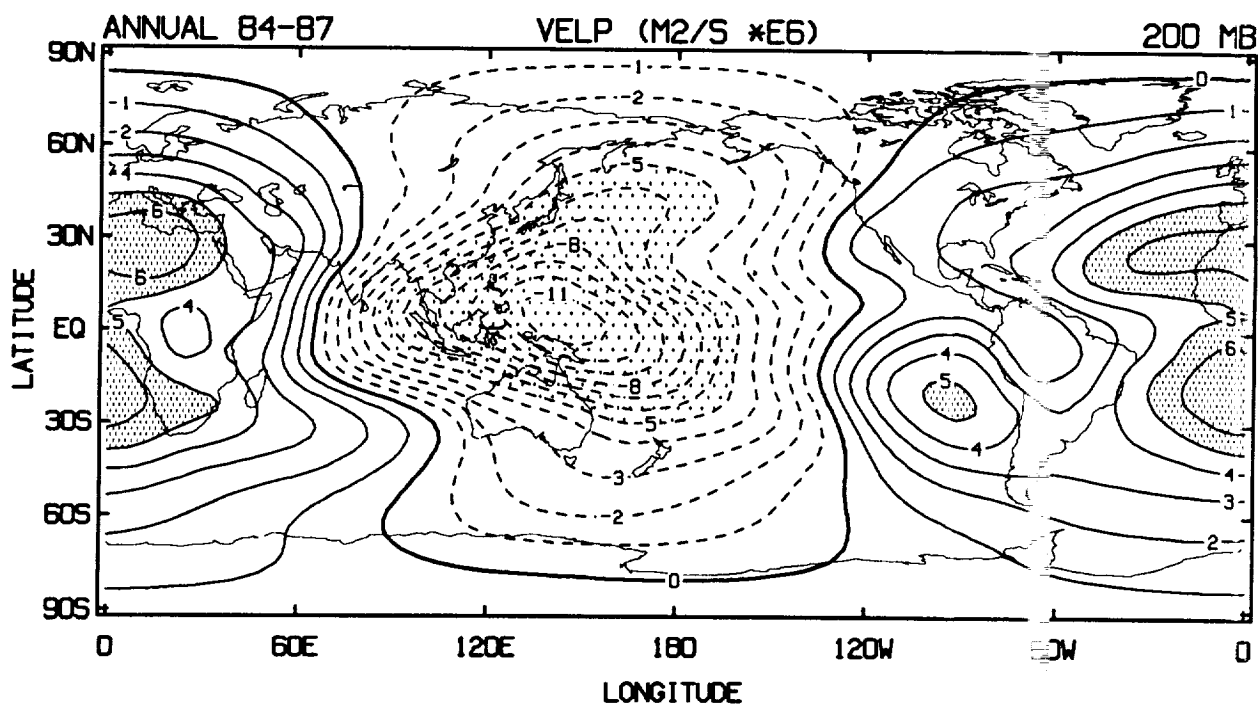
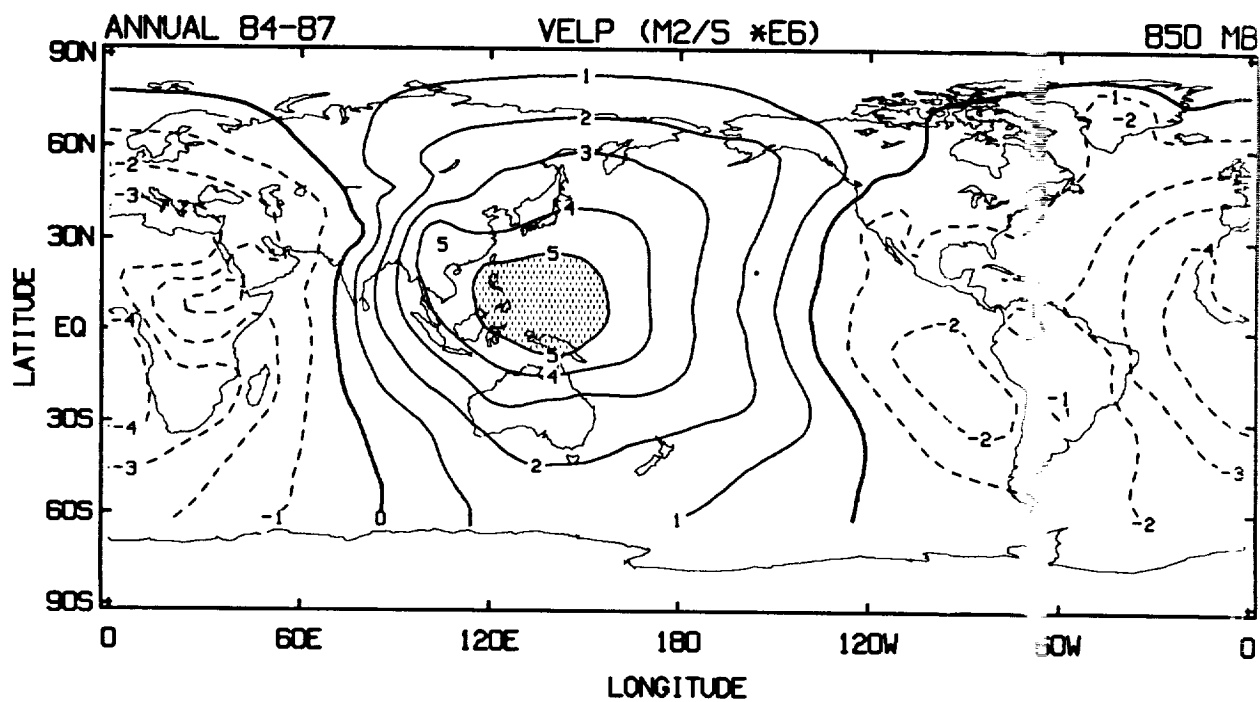


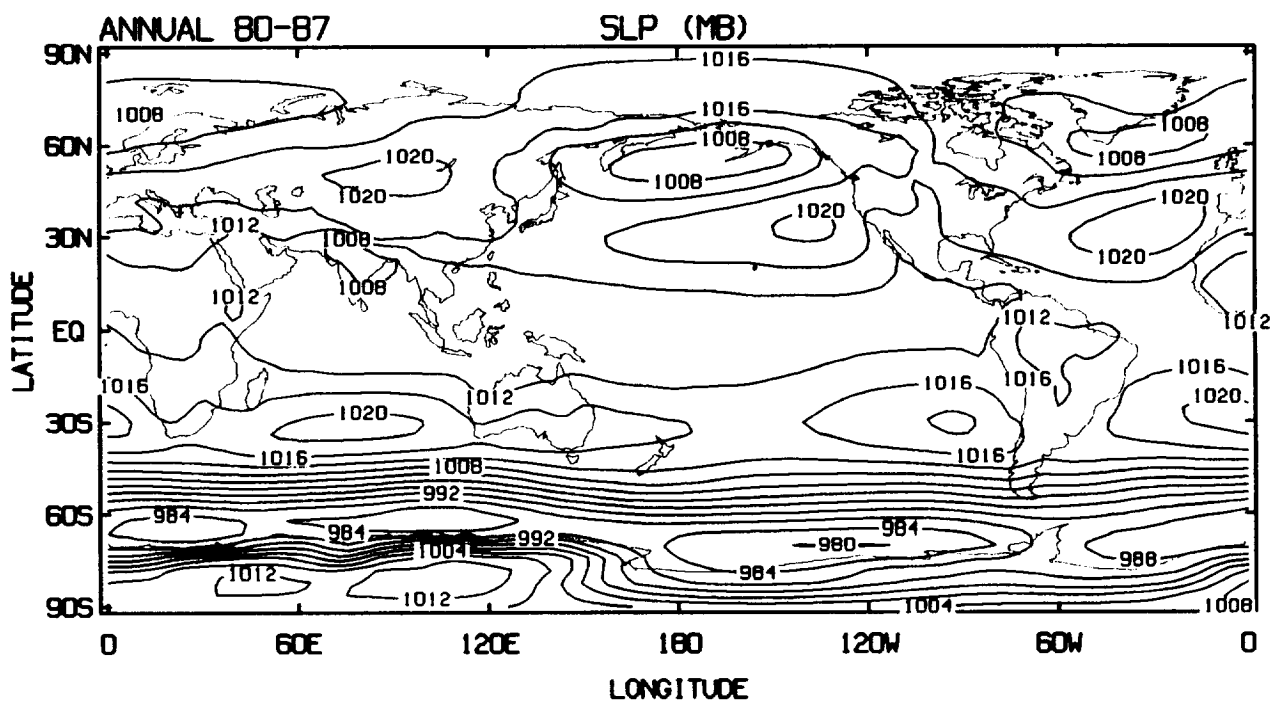


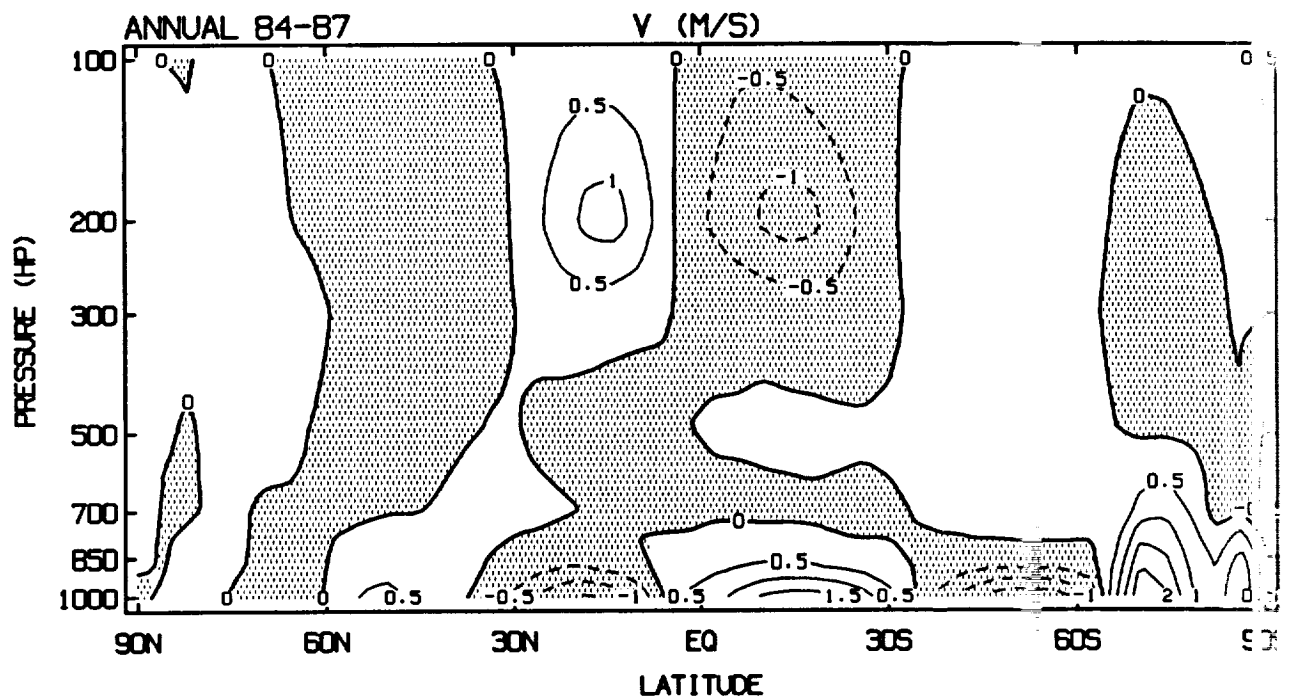
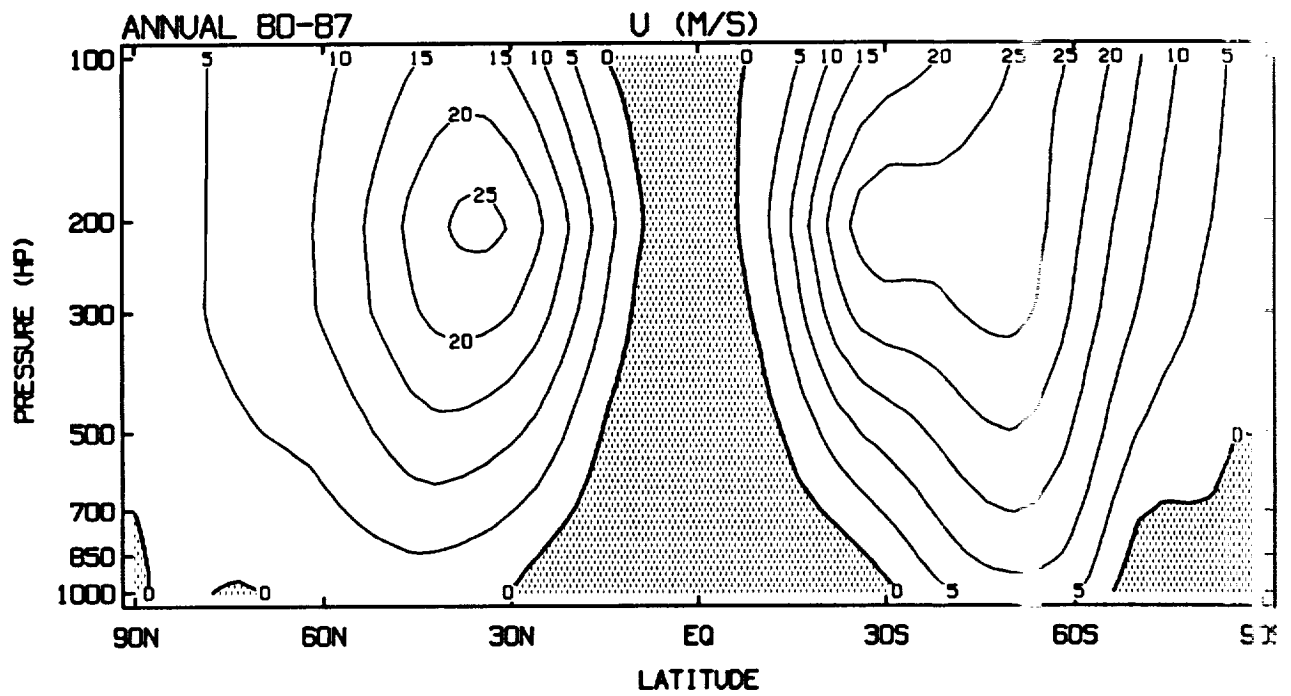


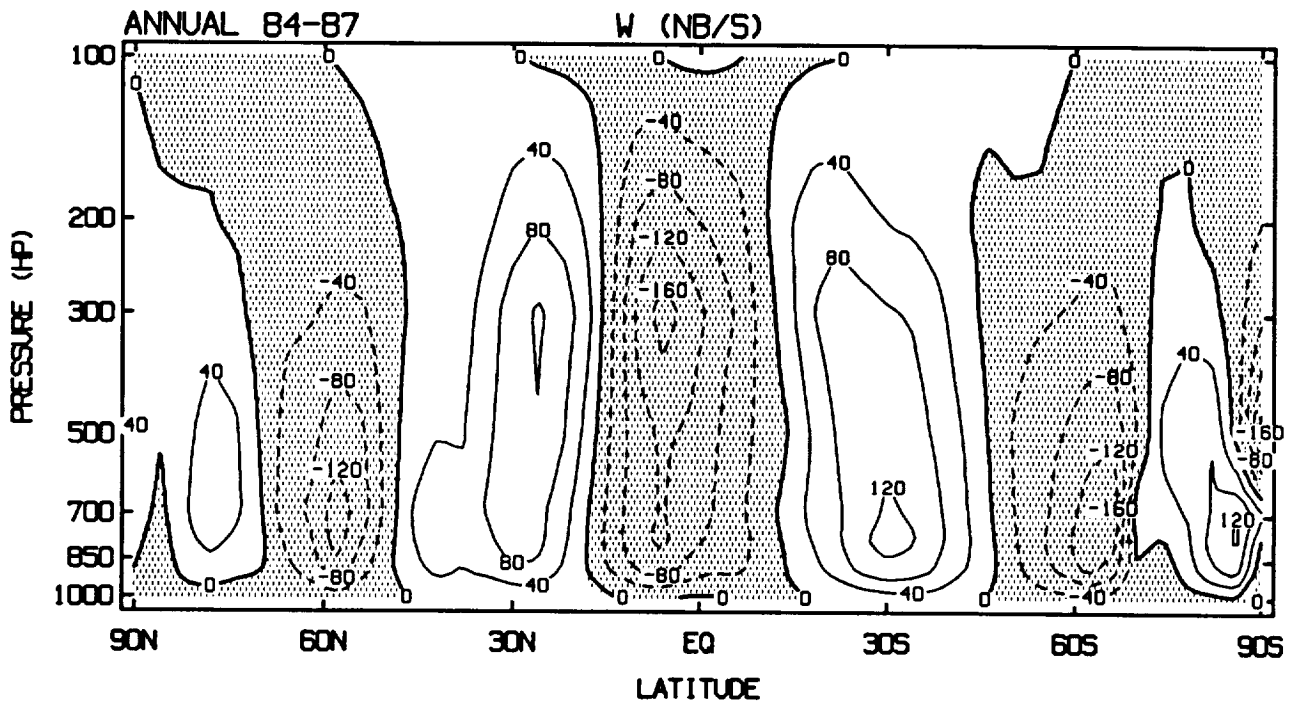
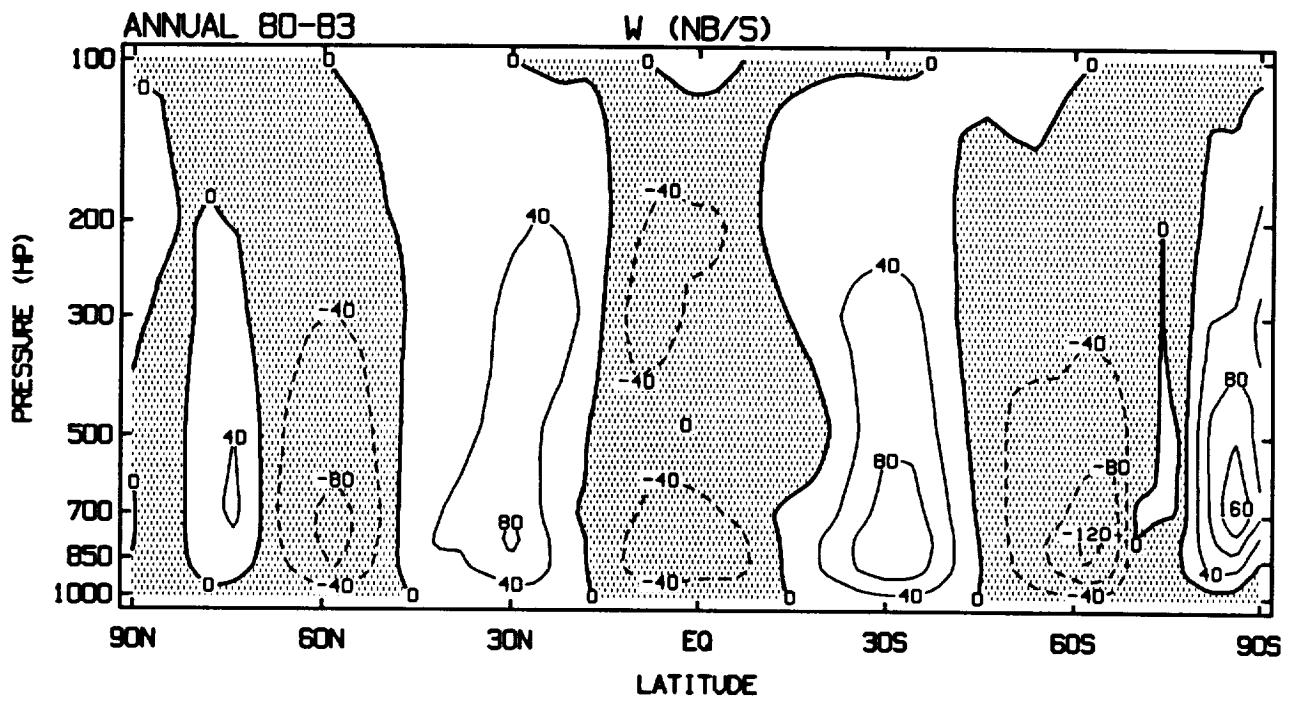


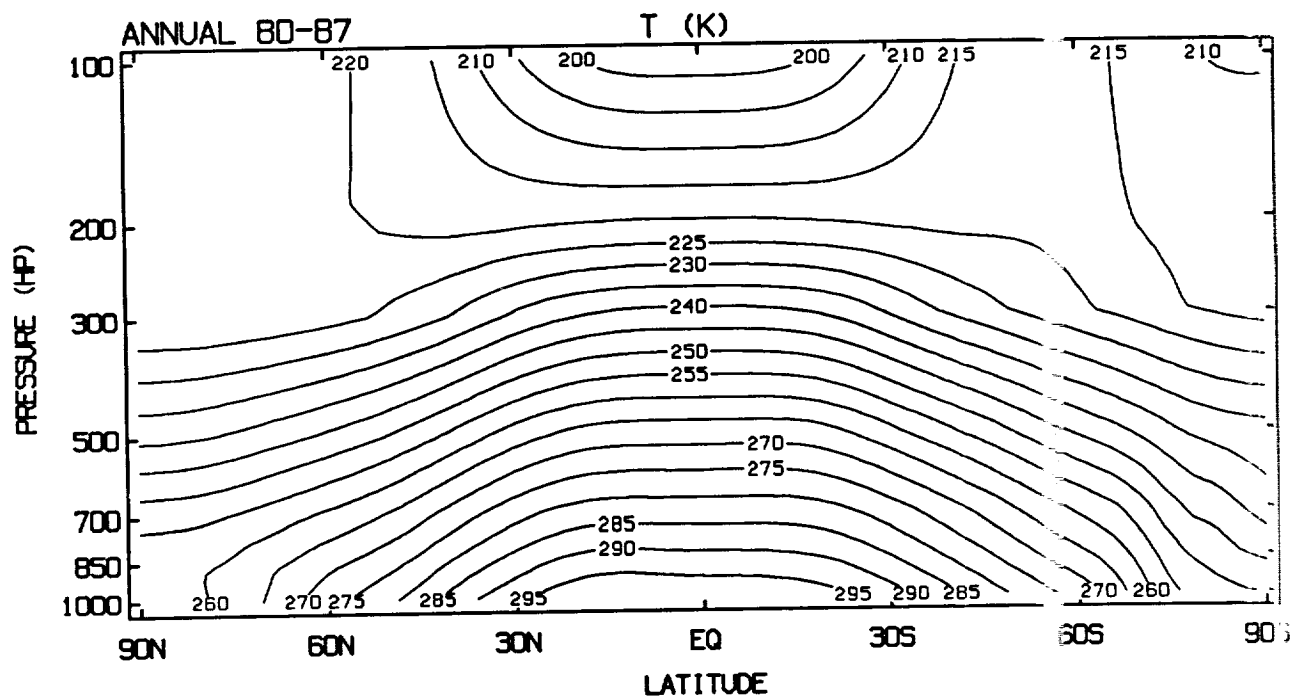
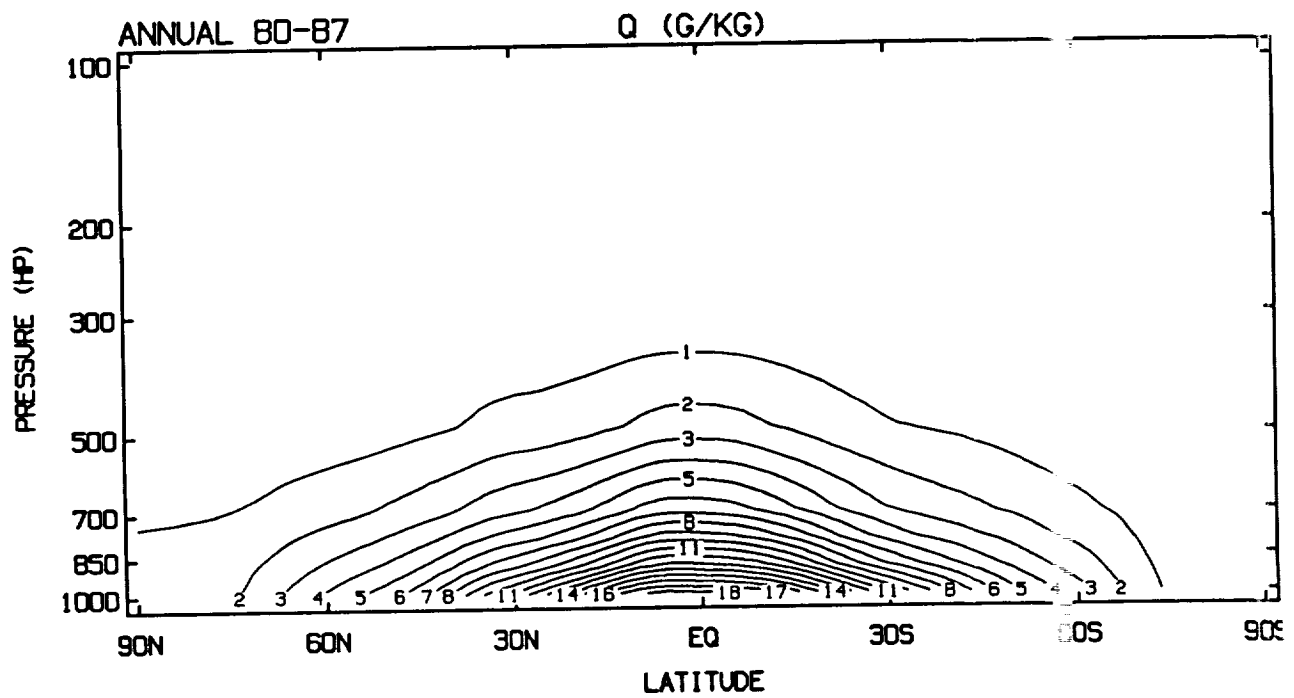




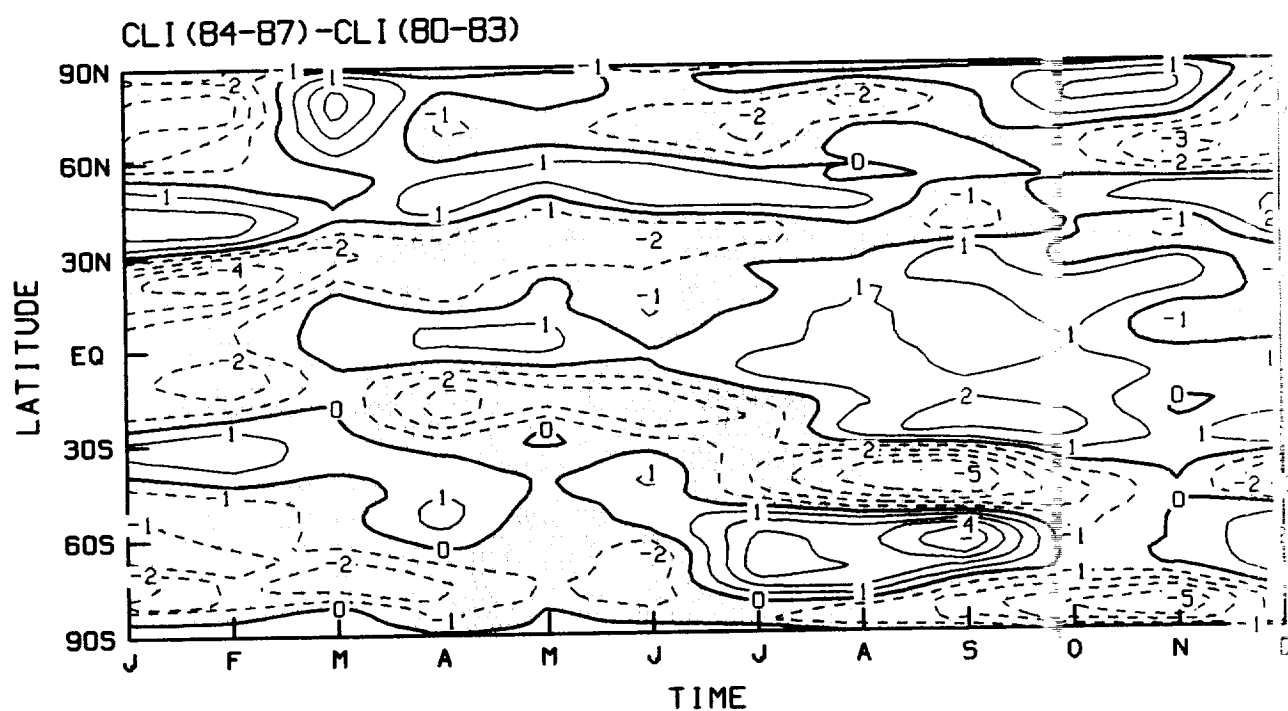
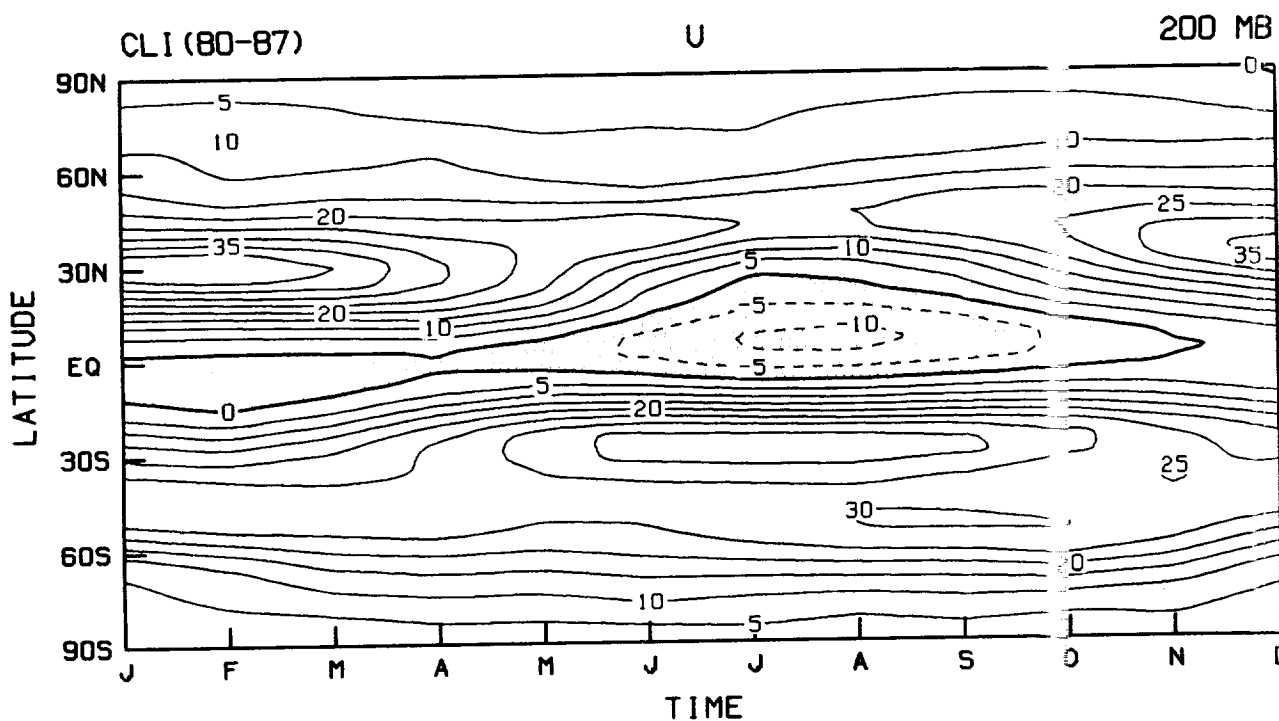


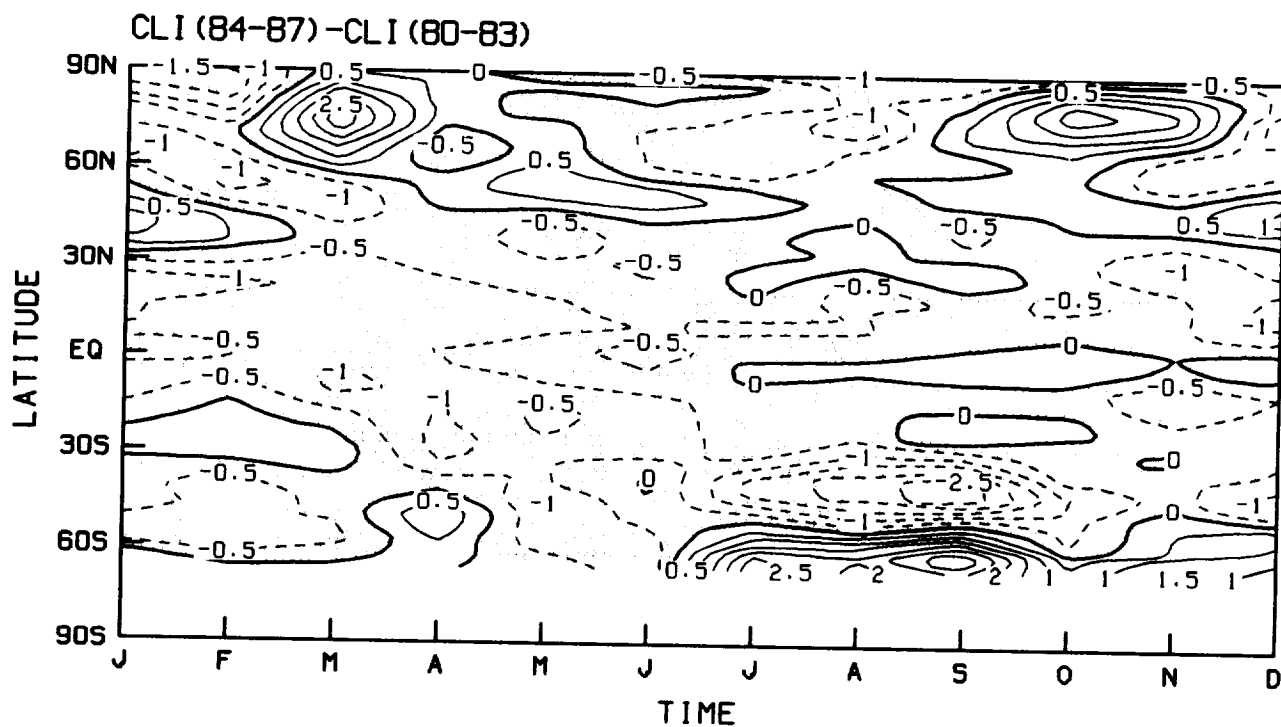
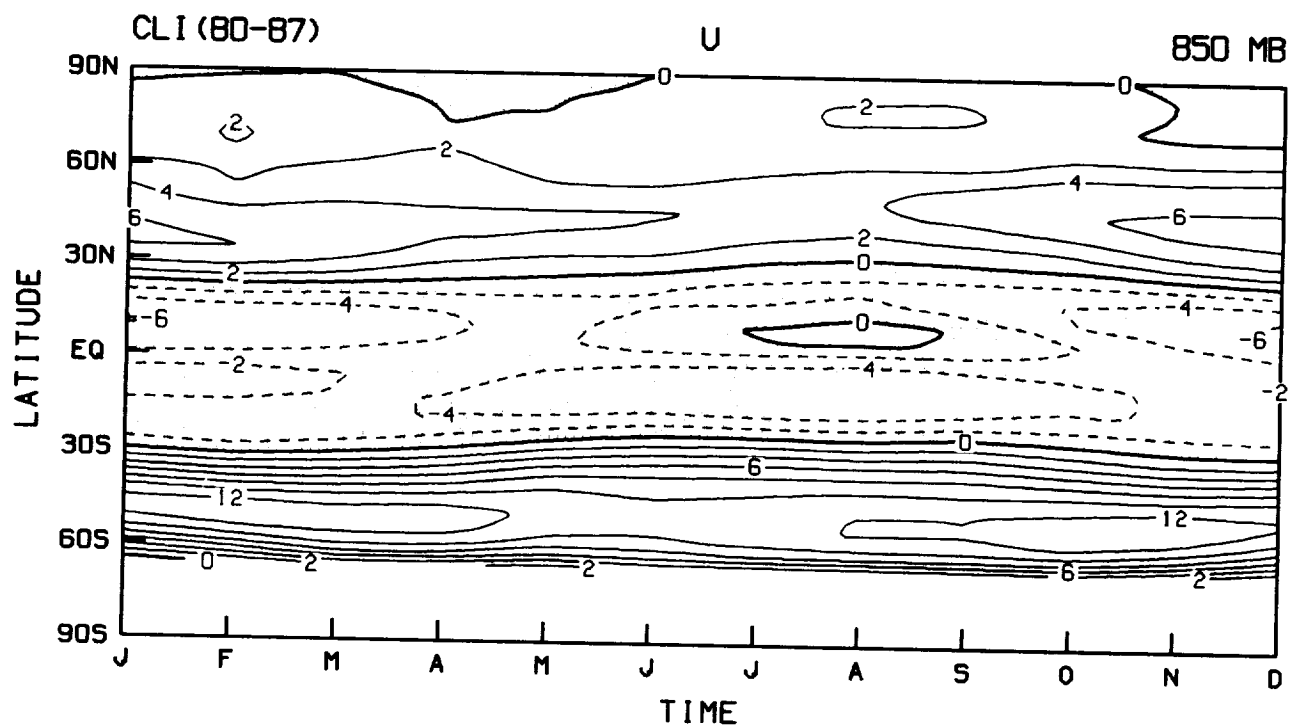


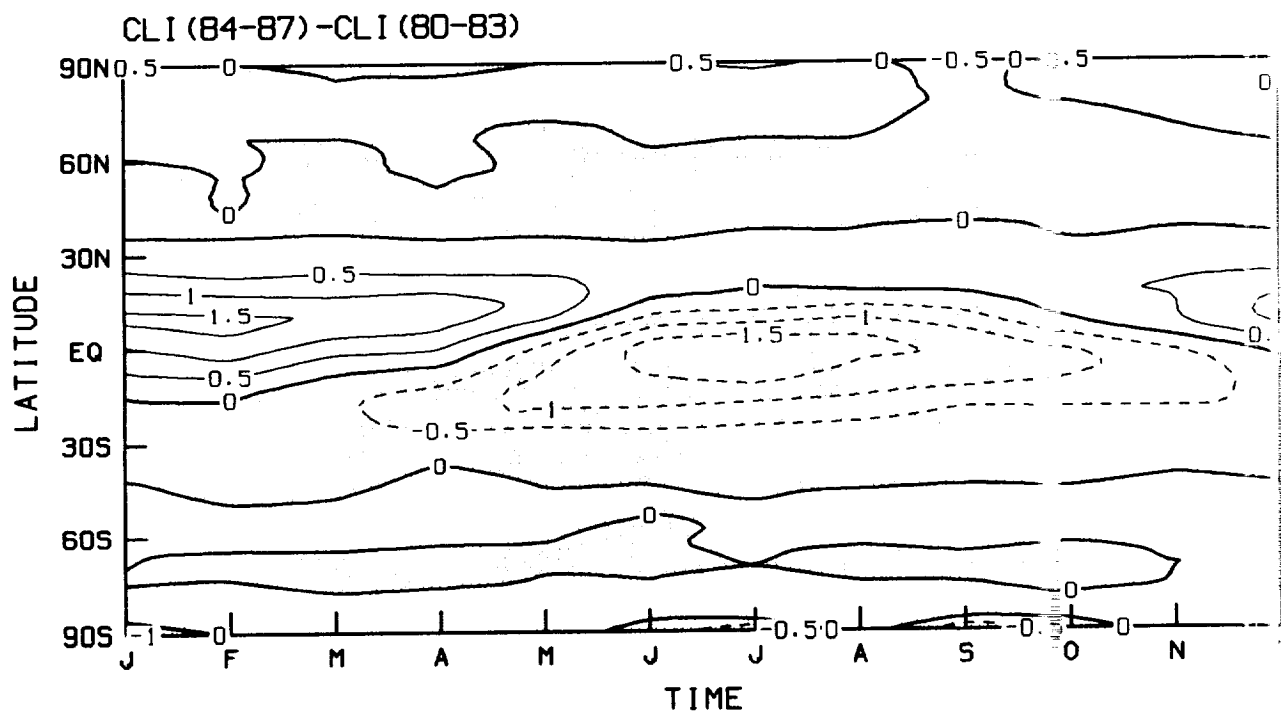
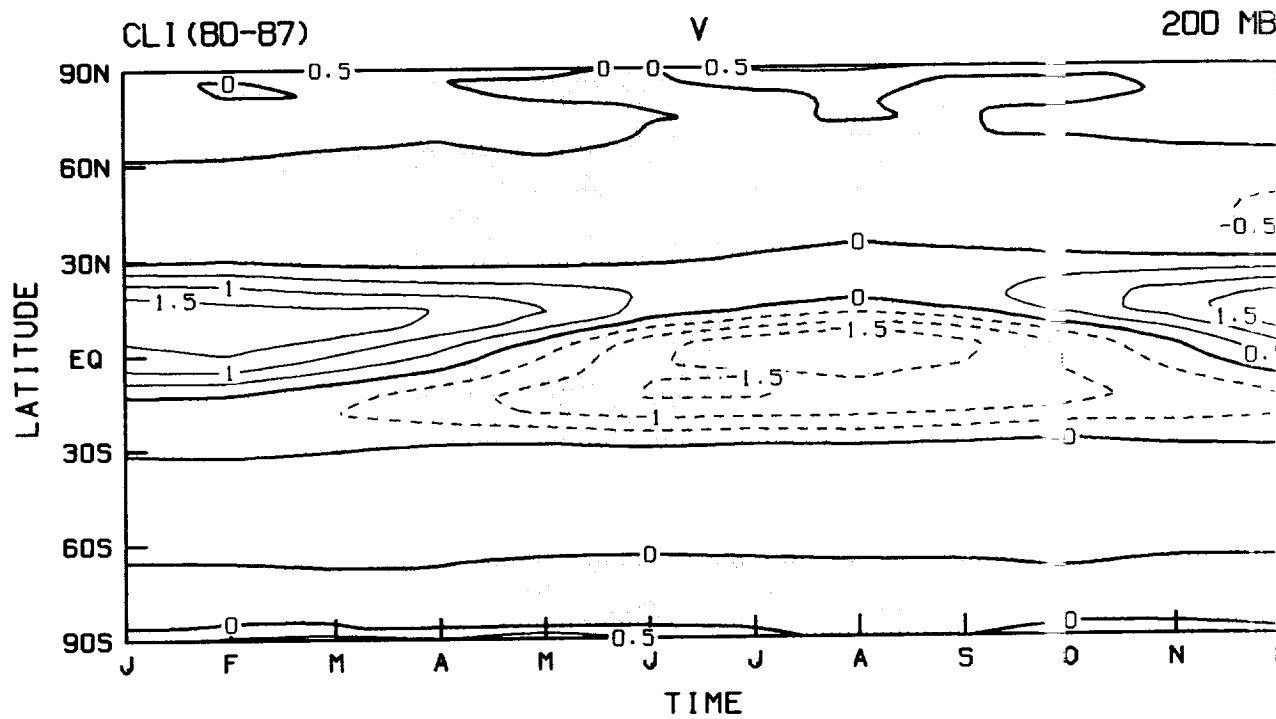


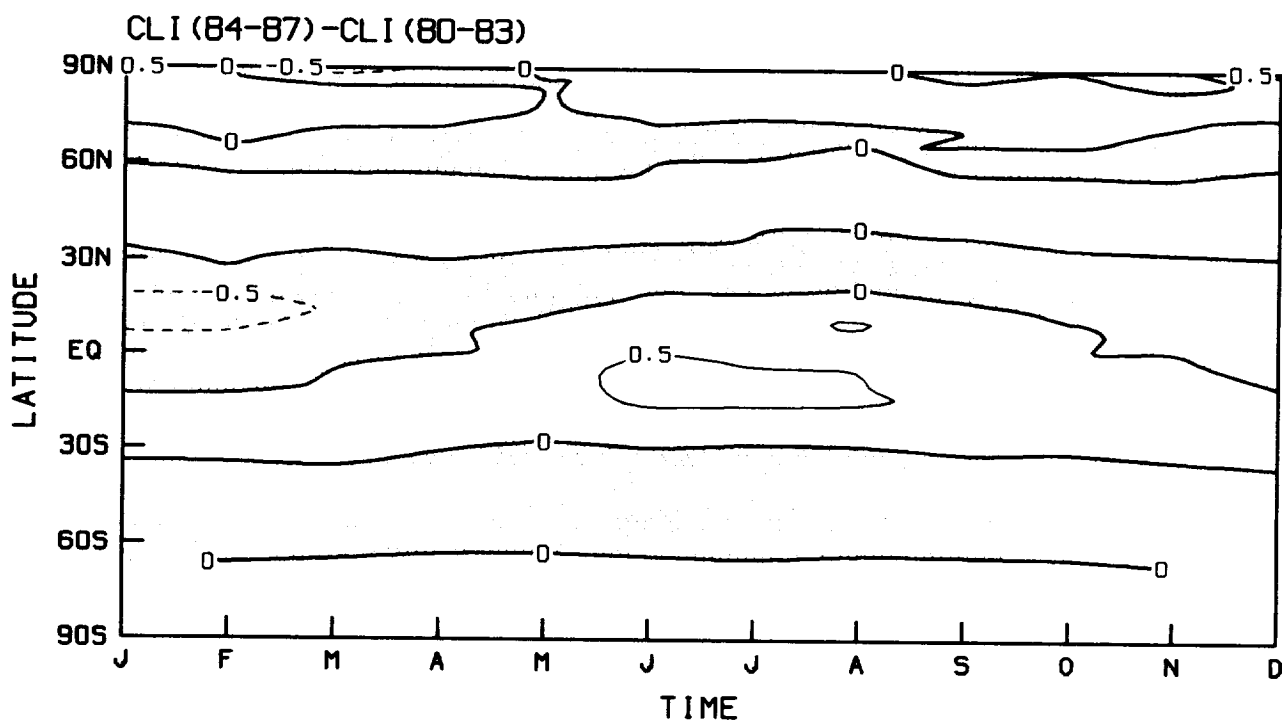
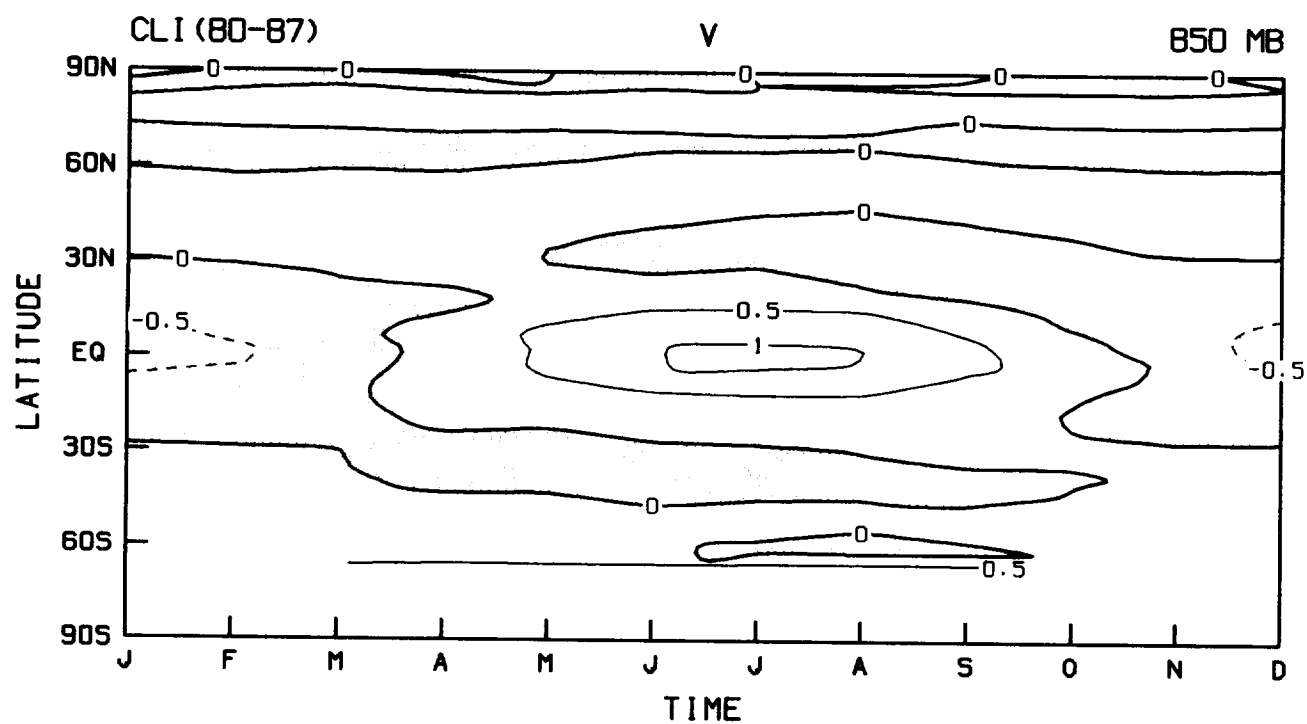


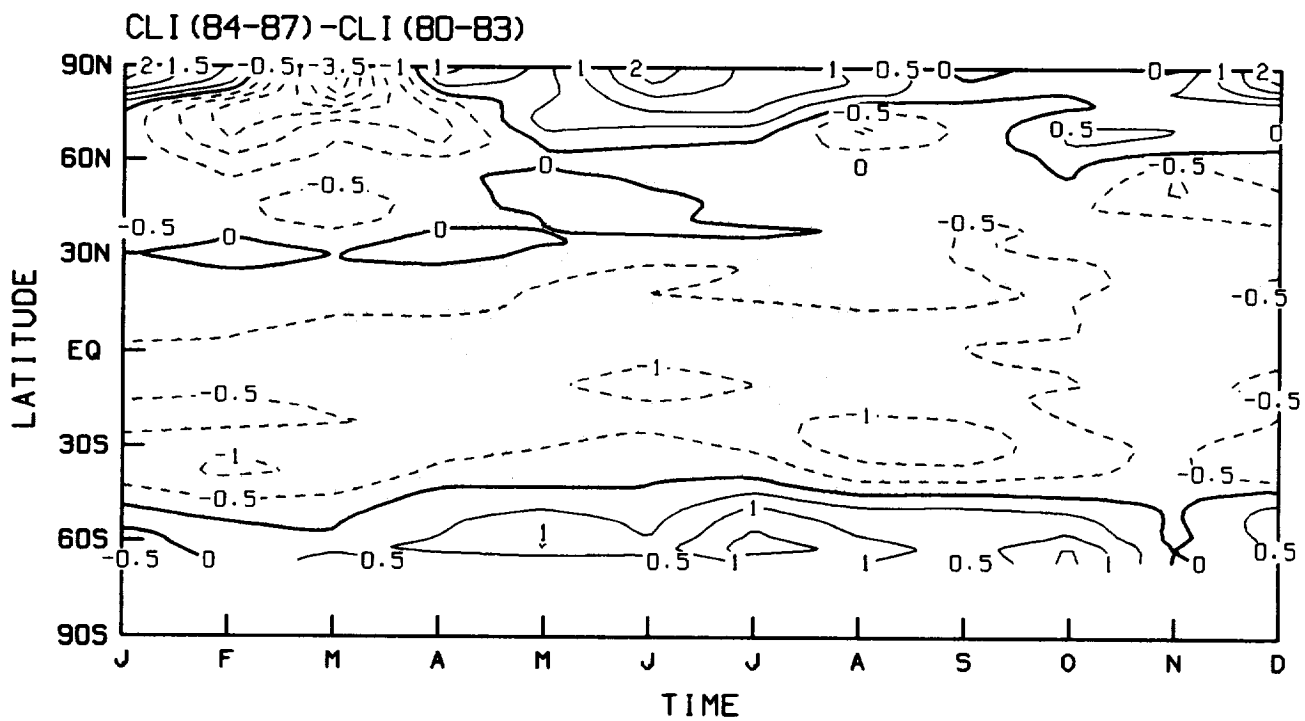
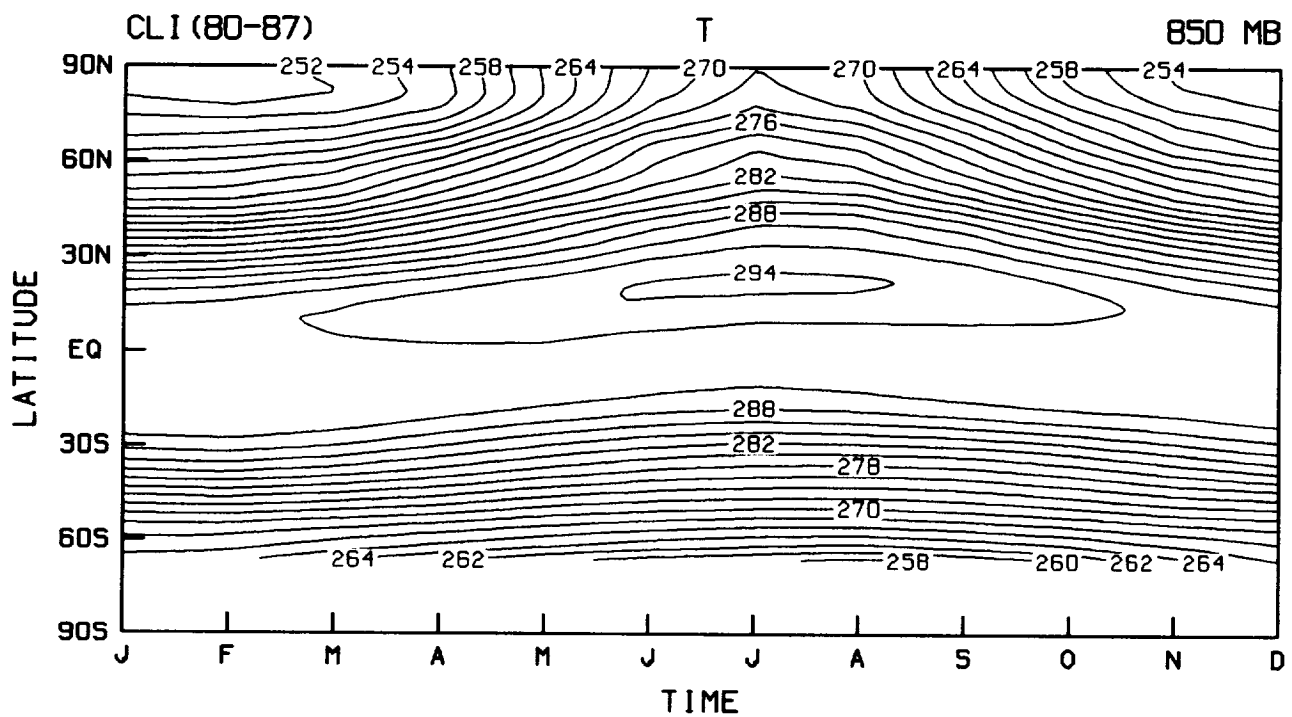
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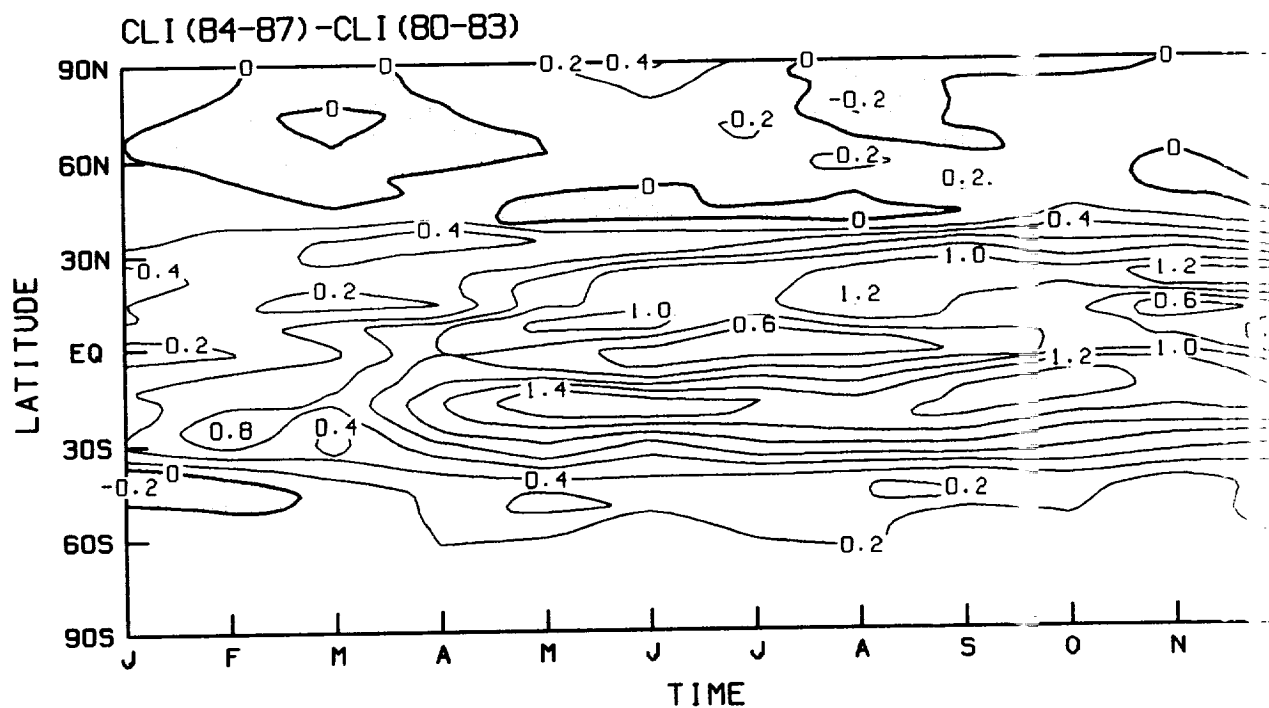
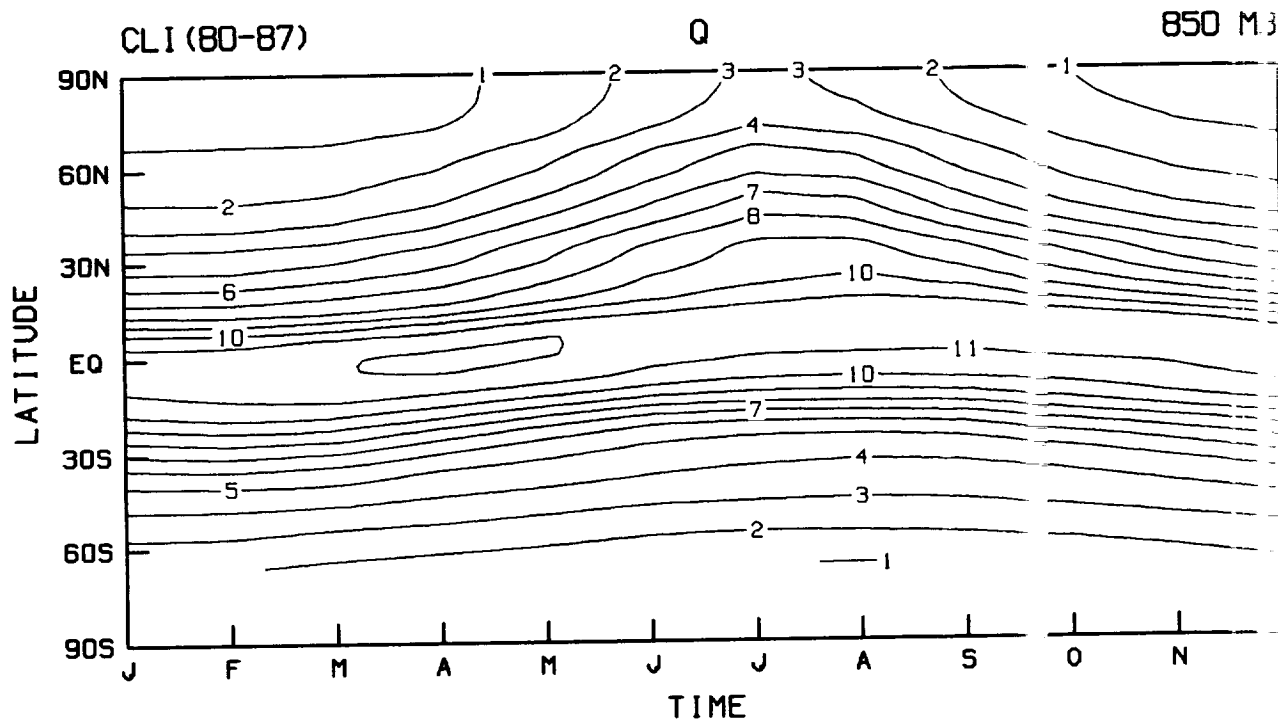


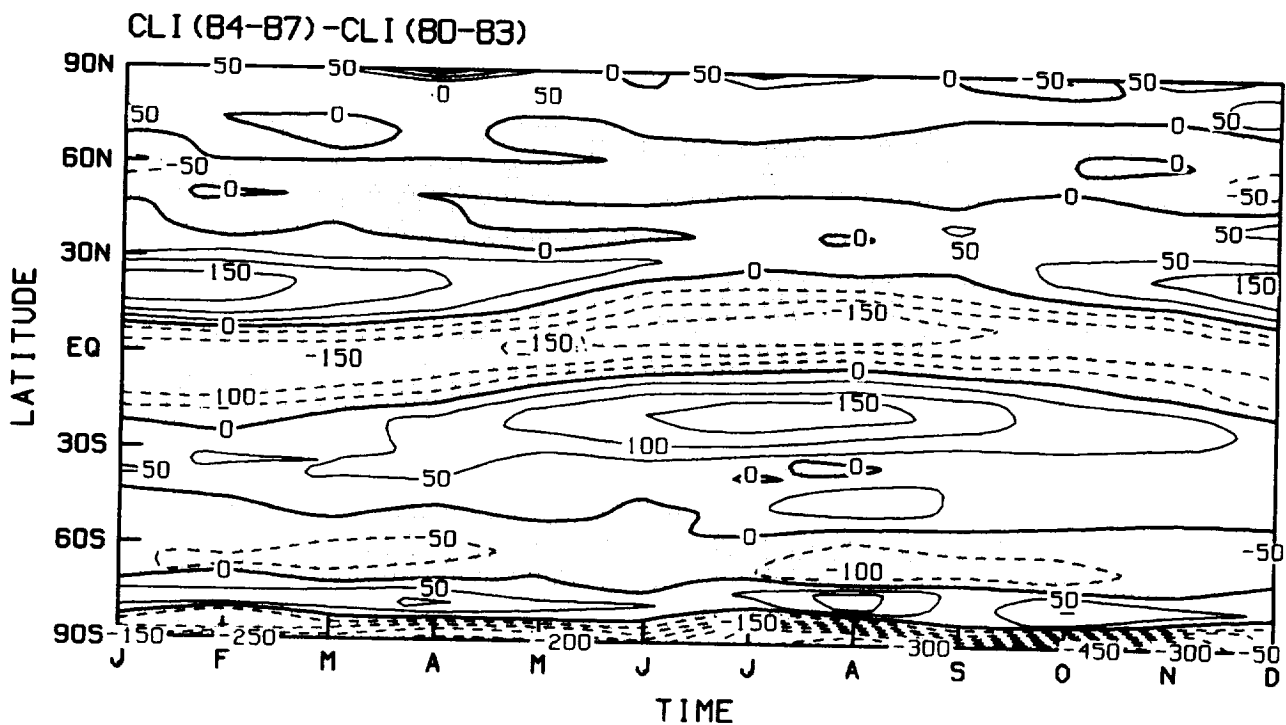
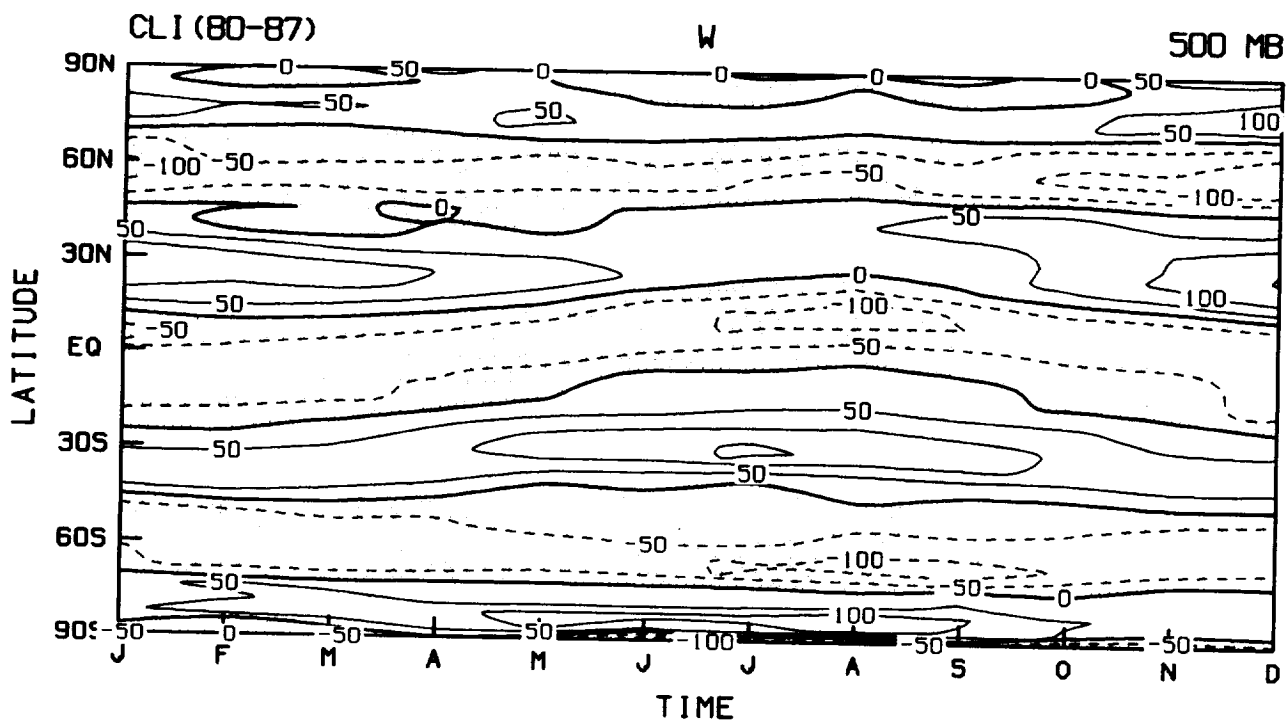




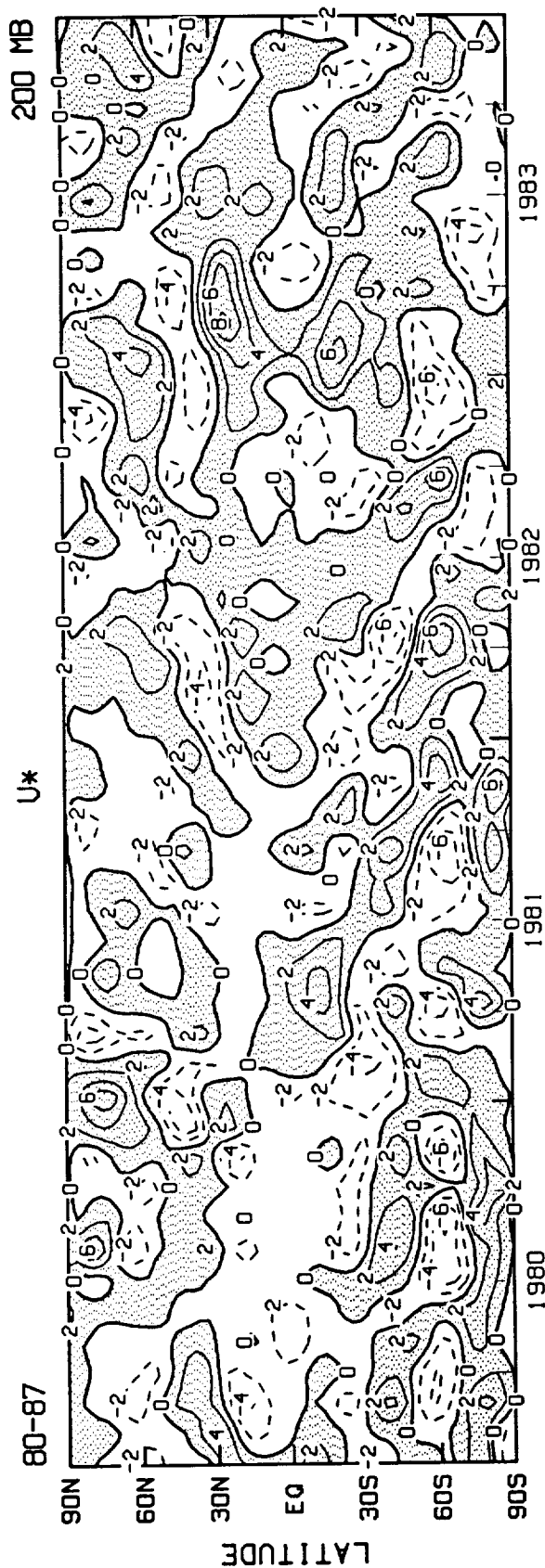




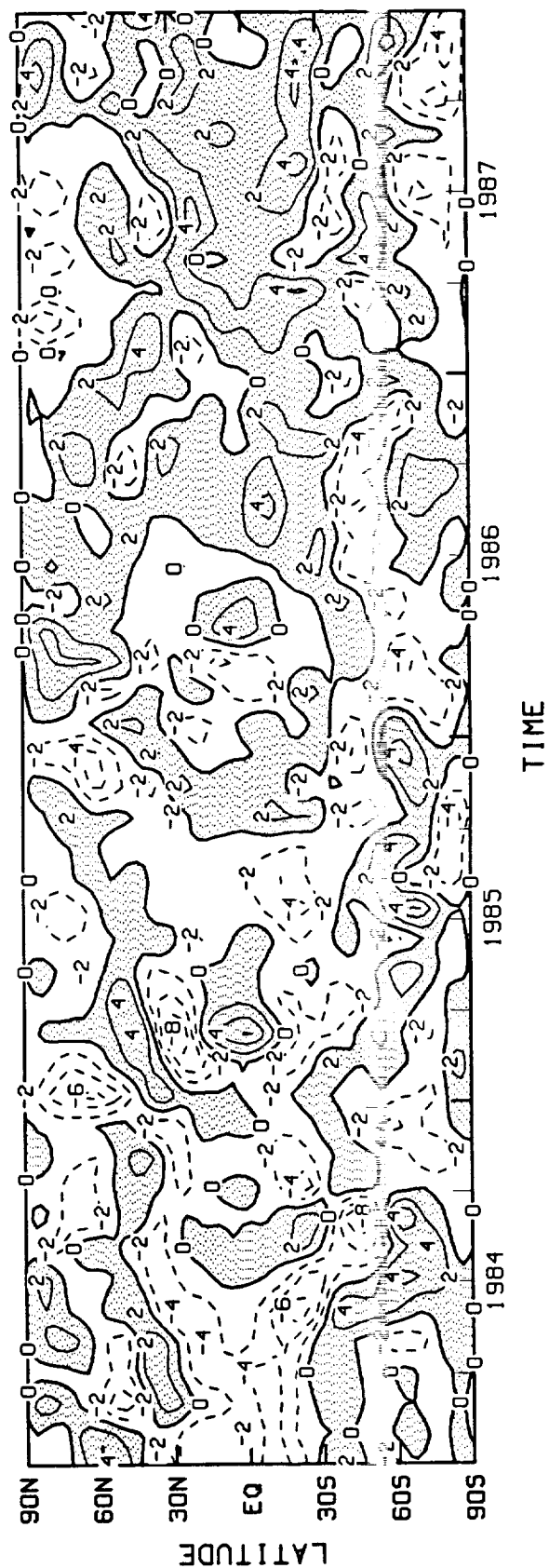


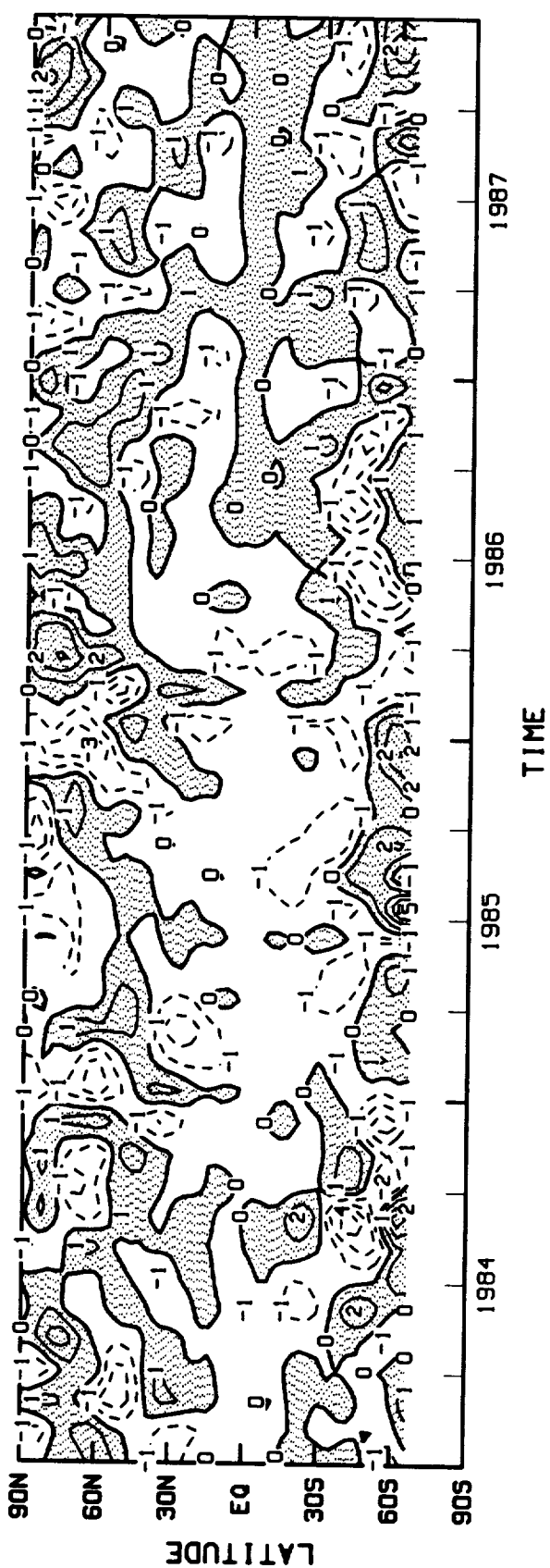
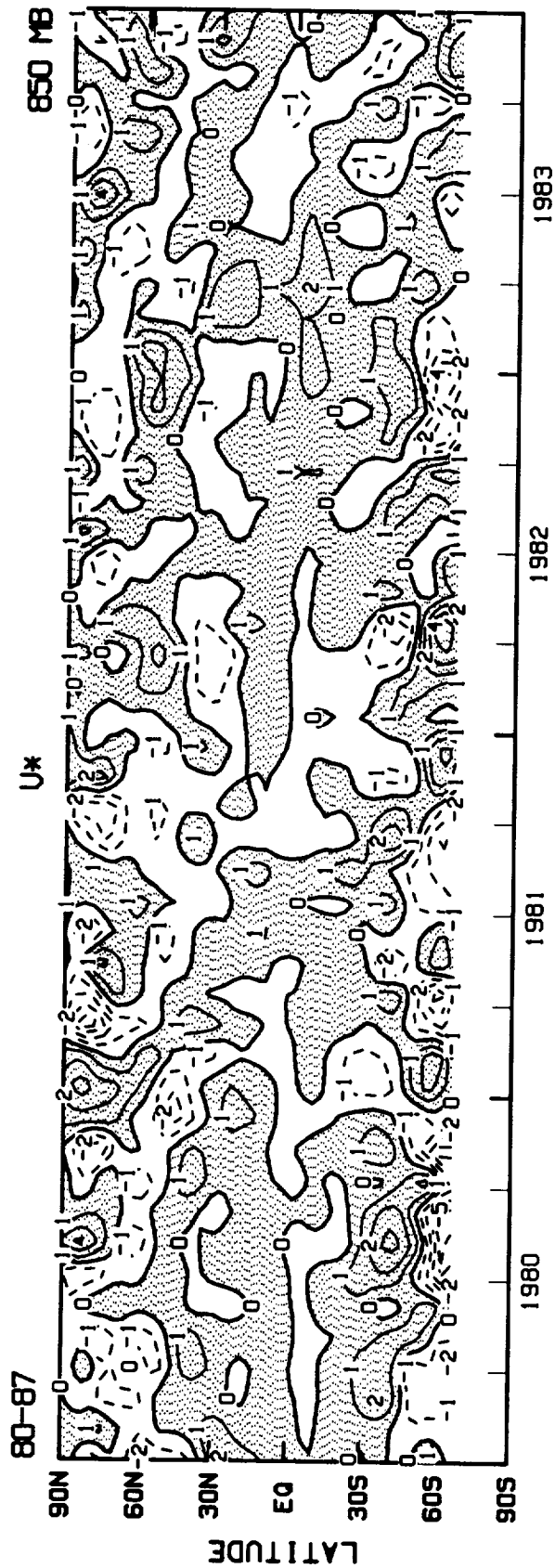


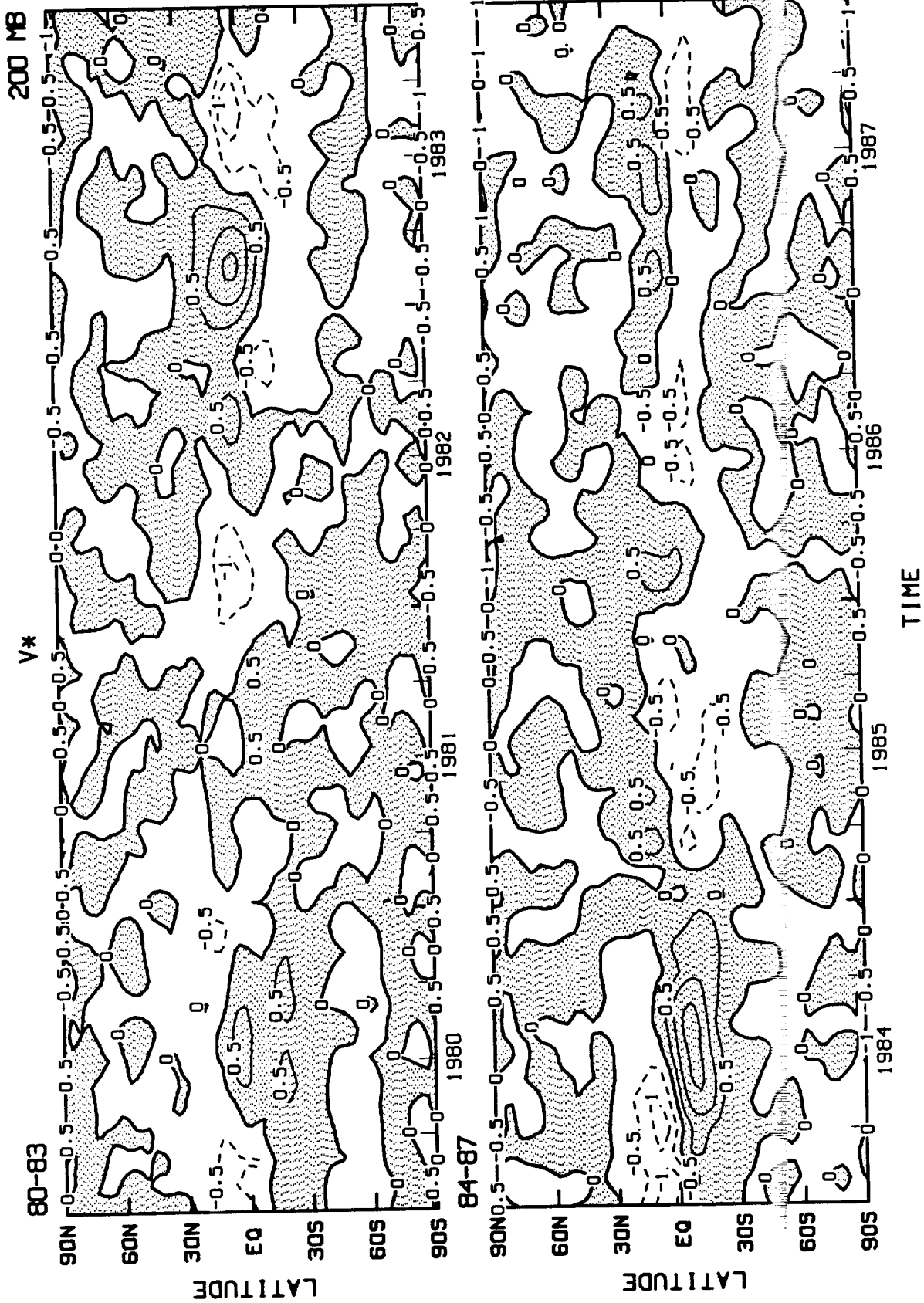
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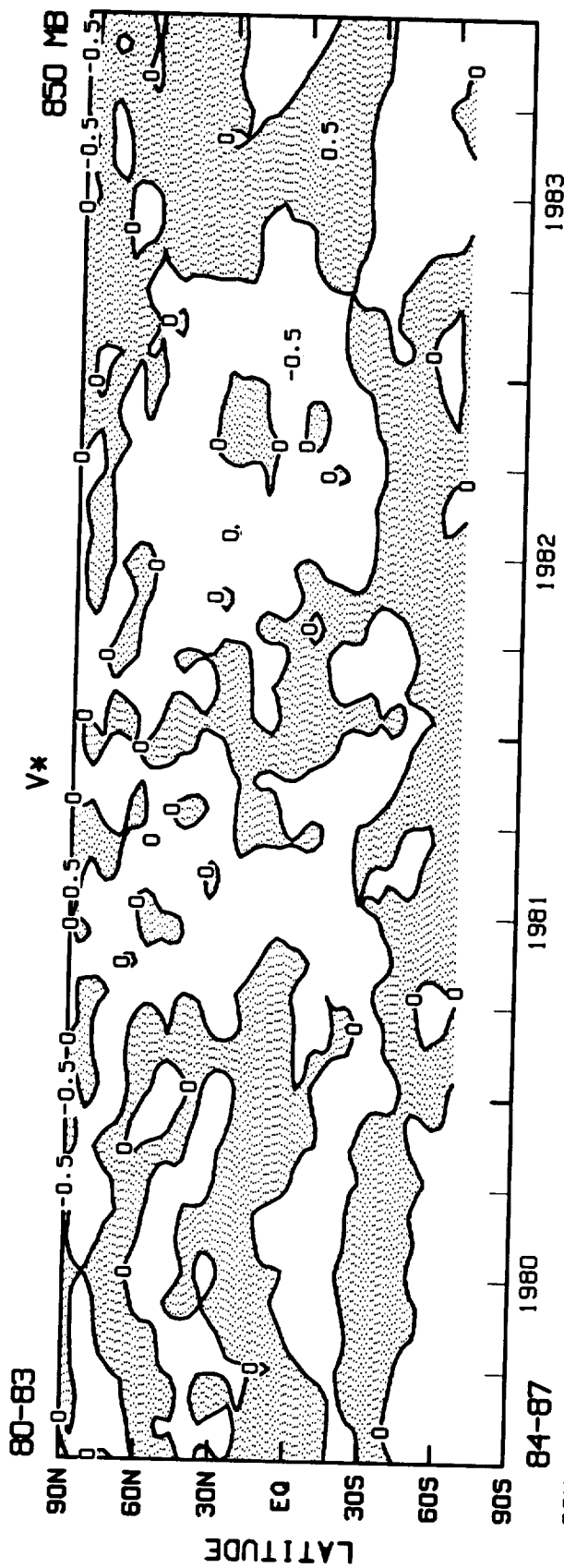


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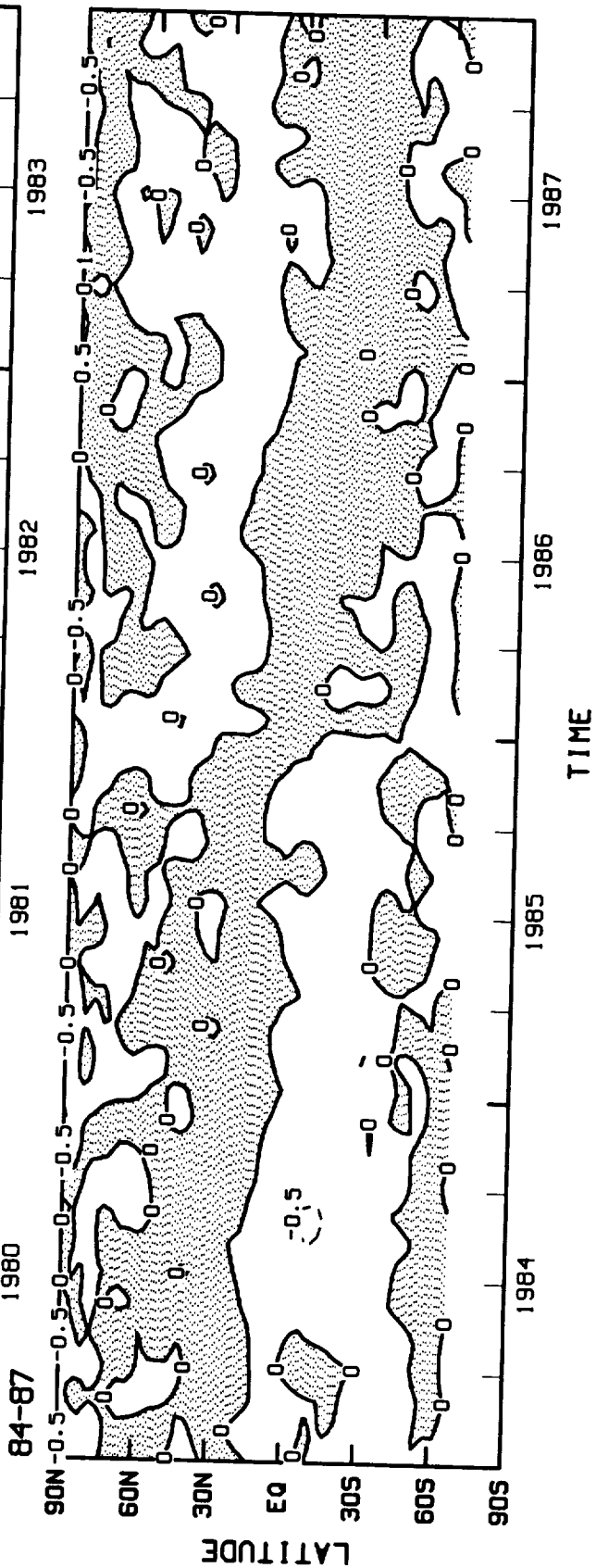


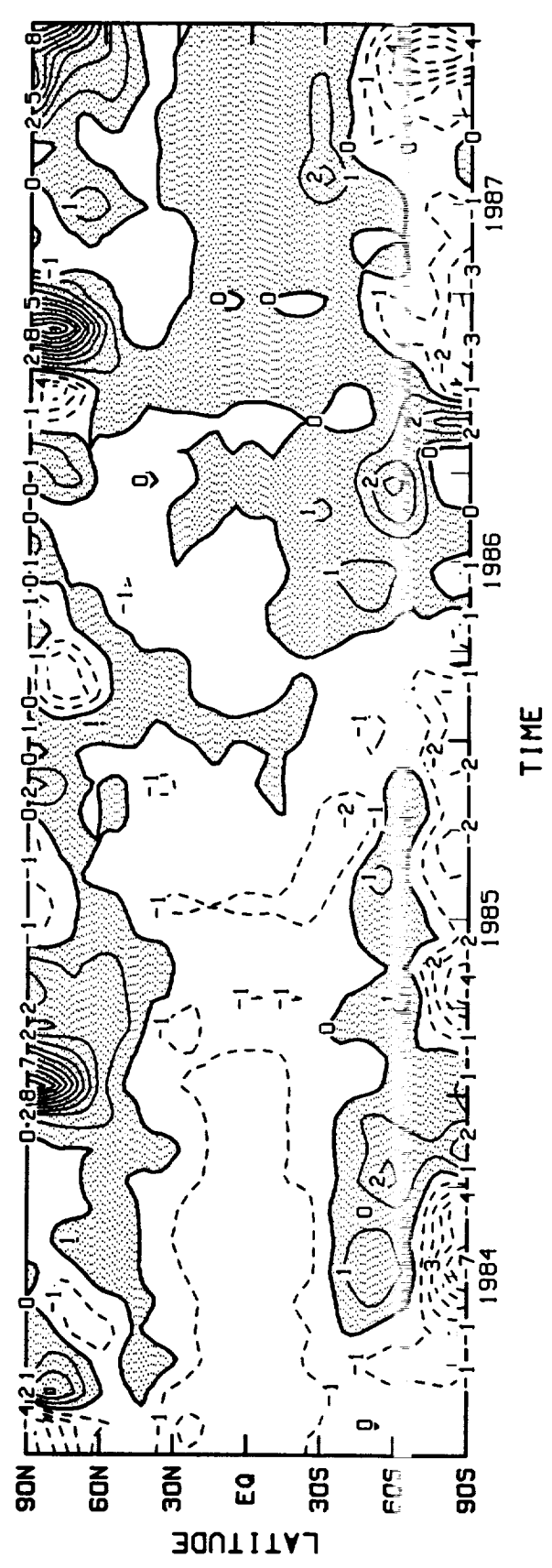
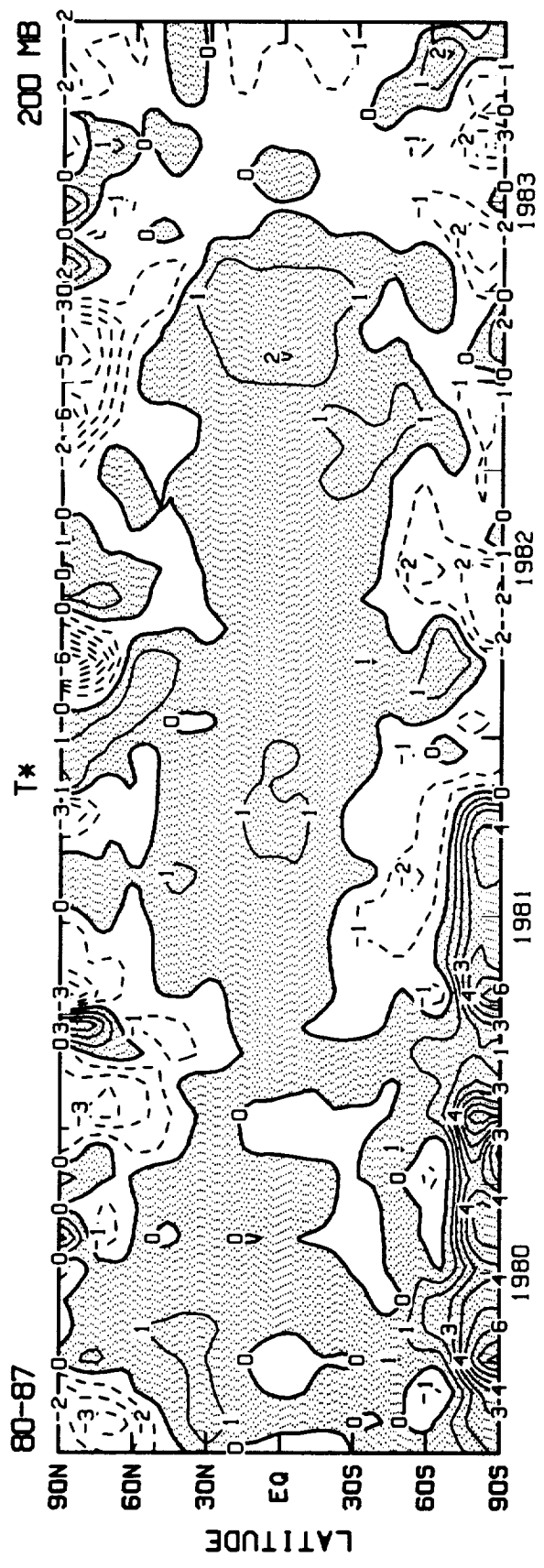


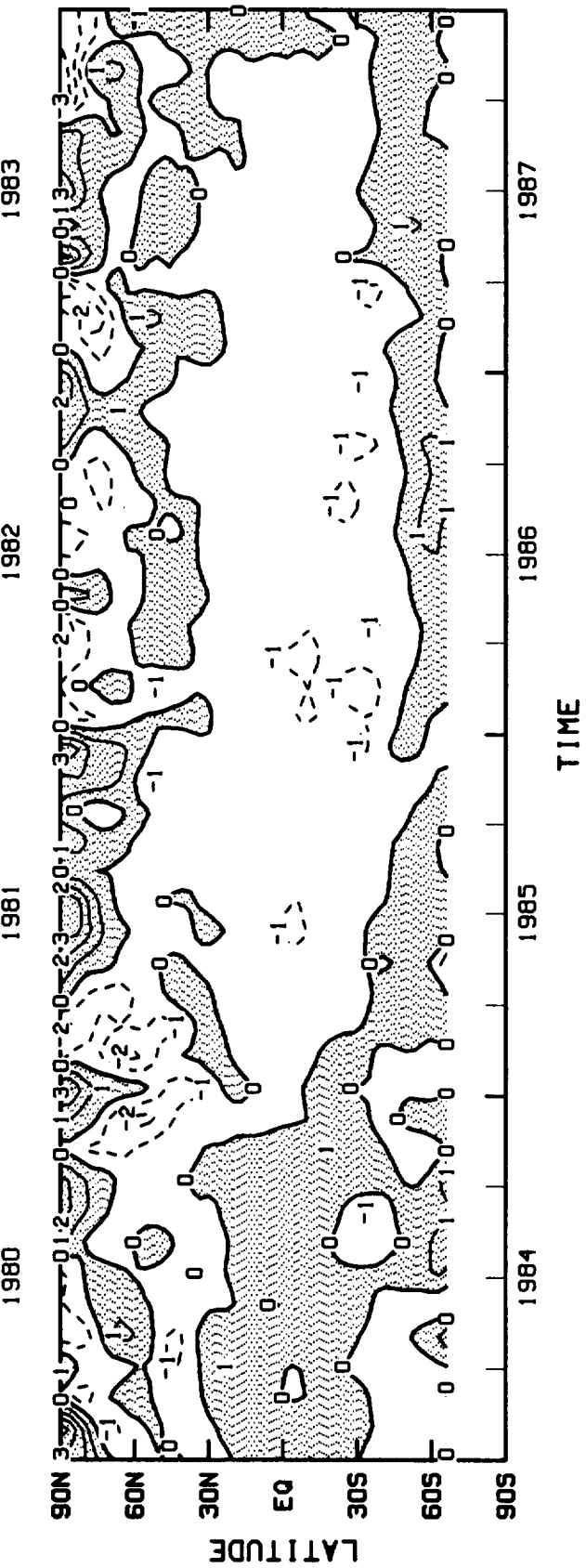
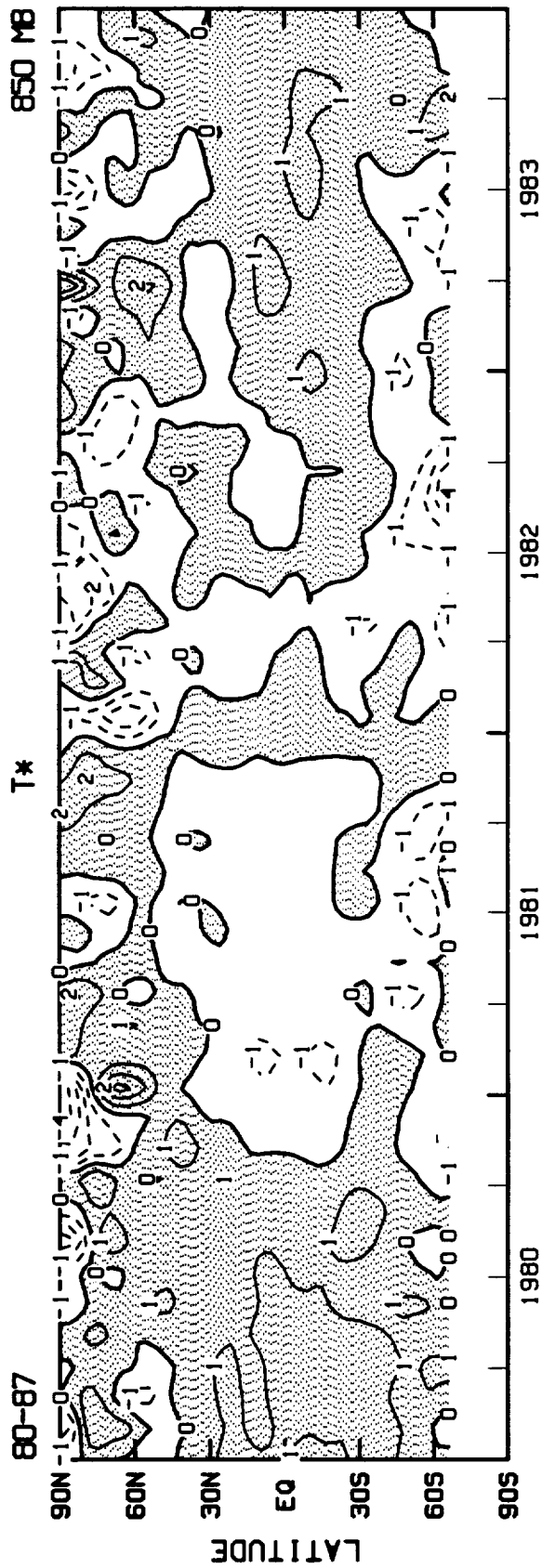


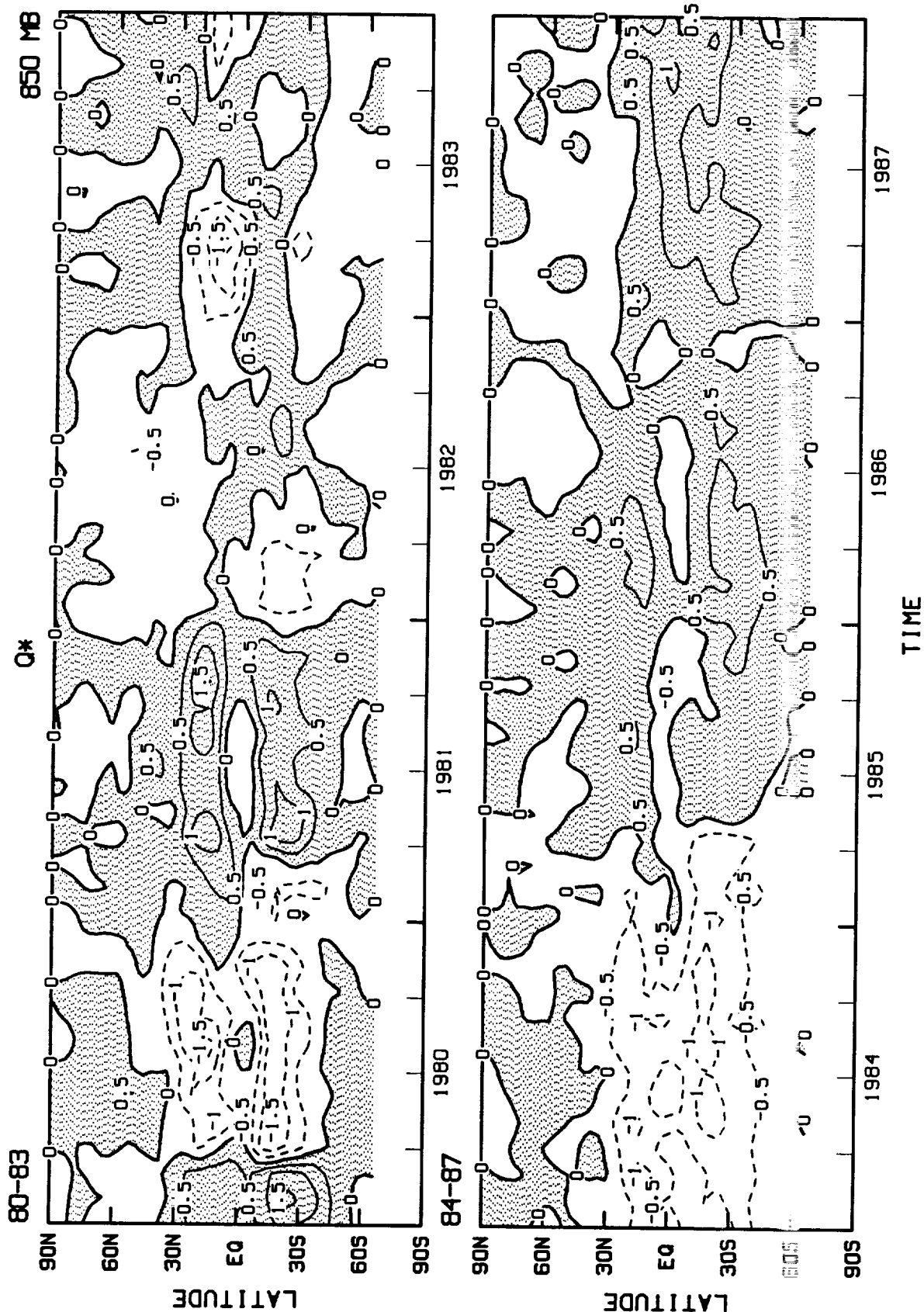


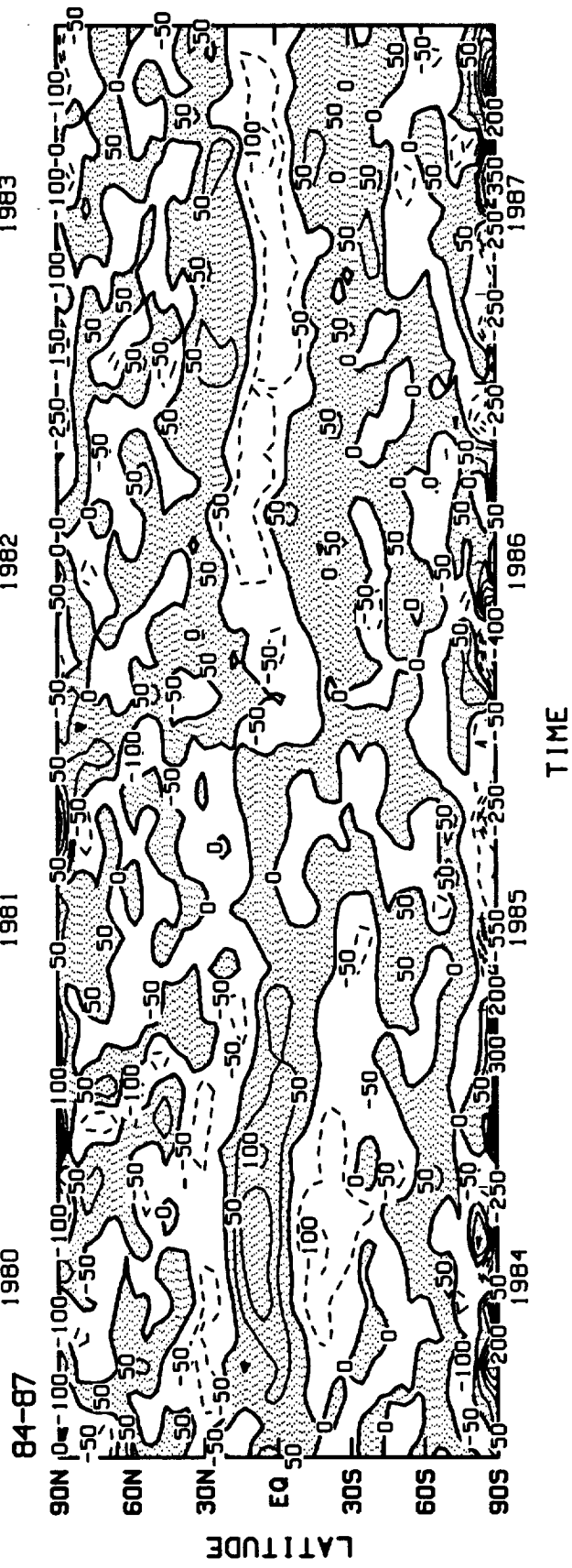
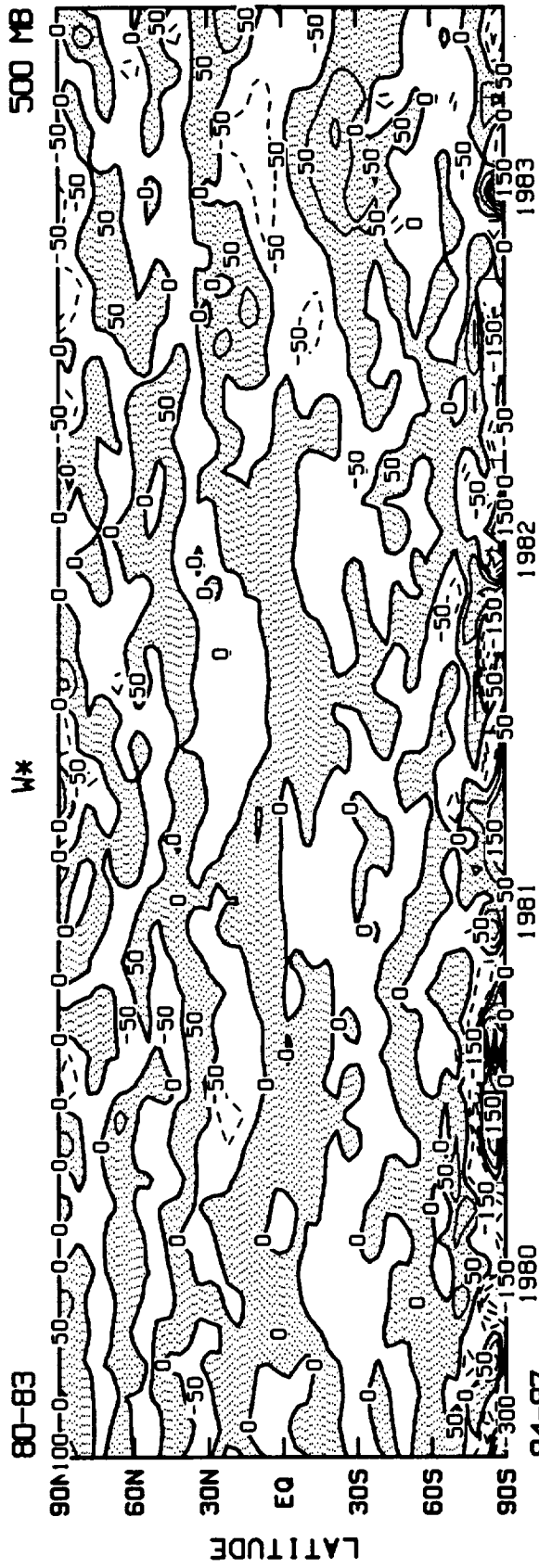
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16. Abstract This document is an atlas of European Center for Medium Range Weather Forecasts (ECMWF) initialized analyses for 1980-87. Various first moment quantities are presented for monthly, seasonal, and annual averages on a global cylindrical projection, as well as cross section maps of zonal averages. Global maps of winds, temperature, stream function, and velocity potential are presented at 850 and 200 mb. In addition, we include global maps of the 300-mb height field (total and eddy), the 500-mb vertical velocity, the 850-mb moisture field and sea level pressure. The average seasonal cycle and anomalies during the 8-year period are presented for selected quantities.					
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